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The Nation the Gainer

THE National Foreign Trade Council and the Chamber of Commerce of the U. S. A. have held their annual conventions in the last two weeks. The meetings were extraordinary in the number and high standing of the business men present, particularly when neither organization can boast of more than six years of existence—the Foreign Trade Council, in fact, of only four. Both organizations have afforded the business interests of the country an opportunity to render a great national service, and these interests construing the opportunity as a duty have responded promptly to the invitation of the founders of these bodies. Though young, they bear none of the earmarks of youth. Guided by the best business brains of the country, they have, it would seem, been born mature, and each is dealing with unusual vigor with the problems within its special scope. One cannot fail in attending the meetings of both to be impressed by the spirit of unselfish co-operation which is dominant. Big interests and small interests share freely their respective experiences, and the thought is frequently expressed that the interests of the country can be served only as there is general progress, general prosperity. The big interests through these meetings give their valuable experience, and learn in turn to sympathize with the problems of the smaller business. Little business, on the other hand, gets not only valuable information and a broader outlook, but, by close view and contact, gets at the true spirit of the directors of big business, with the result that what antagonism it might be inclined to have against big business is dispelled. The result is that the nation is reaping large returns—for business prosperity means the prosperity of the individual.

A Conflict of Dates

AS SCHEDULED the hearing on the government's tentative valuations will be resumed March 19. The Interstate Commerce Commission is probably aware that of the men who sacrificed their time last week and came from all parts of the United States to pack the hearing room to overflowing, a large percentage were engineers. Possibly it has not been brought to the attention of the commission that on March 20 begins the annual meeting of the American Railway Engineering Association, the convention of the year that railroad engineers are most anxious not to miss. Present at the hearing were at least six past presidents of the association, one of whom is in the government service. Members of important committees were also there. Technically, of course, these men, with the exception of the one, are not interested parties in the discussion and the hearing could go on as well without them. Practically, they are all vitally interested in the general principles woven into the whole discussion—so much interested that many of them, if the conflicting dates remain, are likely to have to forego the convention, to its great detriment. This journal hopes that it will be possible for the commission to change the date of the hearing.

Time for Discussion

"THE formal program will be brief, most of the time being available for discussion." So read the announcement in the Engineering Record recently of the coming meeting of the Iowa County Engineers' Road School and Convention, to be held at Ames. We can heartily commend the plan to the many organizations which insist upon overloading their programs, and consequently, instead of treating one or two subjects well, treat many subjects badly. A brief formal program with plenty of time for discussion is particularly desirable at the type of convention that will be held at Ames. In general, however, the same course can be followed to advantage by engineering societies.

K-Trusses Analyzed

DESIGNING engineers will find of more than usual value the complete, yet definite and concise, analysis of the K type of truss made by C. L. Warwick and presented in two parts, the first of which appears in this issue, page 223. Mr. Warwick assumes a truss outline resembling the well-known Quebec cantilever bridge, but makes the treatment general by changing the panel layout and using unequal sub-panel lengths. The truss is treated first as a simple span and then as a cantilever arm (Part II), and influence lines for a typical panel are completely determined. Criteria for maximum stresses are developed and the methods for obtaining such maxima are outlined. The resulting series of equations and influence lines will enable the analysis of any K-truss to be completed by the most direct and concise methods now available. Of special interest is the comparison made by Mr. Warwick to show the difference in action between the K type of secondary system and the usual Pettit-truss secondary system, both statically determinate, but resulting in entirely different distribution of the intermediate panel loads to the main panel points. While the field of application of the K-truss is limited by economy to long spans, Mr. Warwick's analysis should result in more general use of this type, particularly for cantilever bridges.

Federal Valuation and Its Problems

SPACE will not permit more than brief comment on the valuation hearing at Washington all of last week, based on the Valuation Division's first two tentative valuations. A multitude of interesting points were raised. The question of joint property, with all its ramifications involving trackage rights, joint stations, crossings and industry tracks, is in itself one to command much study—as it is evidently one on which none of the parties at interest are ready to declare themselves with too much definiteness. Two subjects, however—and they are probably the two most important, unless subsequent developments bring "other values and elements of value" forward as a candidate—have been discussed and rediscussed, and it is unfortunate that there remain such totally different views thereon. They are the subjects of depreciation and land.

In the matter of depreciation, the carriers, clinging to the idea of one value only, professed to believe that the mere recording of theoretical depreciation means the writing off of possibly 20 per cent of their property. What this journal regards as the answer to this view never seems to be succinctly stated. Director Prouty all but stated it, and the comment of several of the commissioners indicated that they had it in mind. It does not seem possible, however, that the carriers could find a ready answer to the suggestion that the Valuation Act aims to determine sale value as well as value for rate-making, and that the carrier itself would hardly be willing to confine its investigation of a feeder line it sought to buy to an examination of its operating efficiency, ignoring consideration of whether its bridges and stations were good for a long life or would soon have to be replaced. Certainly under such conditions accrued depreciation is a liability.

On the other hand, the attitude of the Division of Valuation is not made more clear when Mr. Farrell, the solicitor, reads from a decision that the deduction of depreciation is proper in rate cases, especially when the decision quoted refers to an entirely different type of property, in which the replacement method of renewals is hardly applicable. Neither, probably, are the carriers reassured by the various views and decisions of state commissions, a composite of which would seem to mean that they believe it right, but frequently not expedient, to deduct depreciation.

Presumably, it is the uncertainty of the carriers as to what use will be made of this depreciation when it is found that prompts them to feel that if it is not found it cannot be used. It is being found, however, and perhaps the carriers could better combat the accuracy of the figures than the existence of what they represent. In saying this, this journal hardly needs to repeat that it believes that the rate base for a properly maintained railroad should be based on 100-per cent value.

Coming to land, the Engineering Record still maintains that the Division of Valuation is not meeting the issue. The division may believe that the Minnesota rate decision renders the reproduction cost of land useless. If that is the law, this journal believes the law should and will be changed. But the Valuation Act says reproduction cost is to be determined, and when the solicitor argues against the determining of a figure that he deems useless on the ground that the Supreme Court has said it cannot be determined, and strives to exclude testimony that might show it can be determined, he appears to be hiding behind a technicality—and in a case involving perhaps a billion dollars. The Supreme Court can manifestly reject one valuation after another as based on conjecture. But can the Supreme Court itself declare a thing impossible, and establish it as such beyond appeal? Is that not a matter of fact and not of law? The carriers can produce volumes of evidence showing that railroad land usually does cost far more than the average acreage value. If they desire to, should they not be heard?

The Engineering Record regrets that Director Prouty, who gave evidence at the hearing of having a definite reason for practically everything he was doing and who seemed to be willing without too much citation of legal precedents to explain those reasons, did not set forth his own views on this particular question. It hopes, however, that it interpreted the signs correctly, that the commission will adopt the same policy the division has adopted with regard to depreciation—that of recording the facts—and leave to the future whether those facts, under the law as it then is, will be of any use in determining value.

Franco-American Trade

CLOSER study of the requirements of the French market, more generous handling of credits, suitable adjustments in the American schedule of tariffs on French imports and an adequate merchant marine are among the things this country needs to become an important factor in European reconstruction after the close of the present war, according to the report of the American Industrial Commission to France, sent abroad last fall by the American Manufacturers' Export Association.

It is pointed out in the report that there can be no extensive foreign trade without an exchange of goods. At the present time many of the commodities sent to this country from France are classed by the United States Government as luxuries, and taxed accordingly. These articles include products of some of the largest industries in France, and it is natural that from the foreign point of view our import duties on them should seem exorbitant. It is pointed out that France has had for some time a maximum and minimum tariff, which has enabled it to bargain with other nations in conducting its foreign trade, and that the United States is practically the only important country against which all of the maximum duties are still in force. The report expresses the hope that the newly created tariff commission will be able to adjust this situation so that more cordial relations can follow.

The report points out that many hundred million dollars' worth of industrial reconstruction must be undertaken in France alone on the declaration of peace. The building materials, supplies, machine tools and finally much of the raw material to enable the new plants to begin operation should naturally be supplied from this country. However, the sales will have to be made to a large extent on credit. The report makes it plain that, while the French business man is one of the best credit risks in the world, the treatment accorded him when he has sought to purchase supplies in the American market has so far not been of a character to induce him to extend trade relations with us beyond the point of his absolute necessities.

These facts are brought home to the reader in a thorough and convincing manner, which leads one to expect that the publication and circulation of the report will do much to remove the causes of friction referred to. The commission was furnished with extraordinary facilities for inspecting conditions in all the industries throughout France, and much detailed information is to be found in the document which will be of great value to Americans interested in this market. One cannot read the report without feeling that the size of the opportunity placed before this country by the extraordinary conditions prevailing abroad has been grossly underestimated.

The Compensations of War

WE have broken off diplomatic relations with Germany. Possibly before this issue reaches its readers we shall be at war. We do not desire war, but we embrace it willingly as the lesser of two evils—the alternative being the sacrifice of our national honor.

But if war comes, will it be an unmixed evil? If we are to judge by the conditions we find in England to-day we shall have to answer "No." For the result that we shall describe the price is indeed high, but the result is none the less good, and it comes, as one might say, as a byproduct of the great calamity.

While the British press and British citizens may not say it in so many words, they admit, by recognizing clearly the conditions, that England was, industrially at least, decadent before the war. The employees had the upper hand industrially. Apprentices and output were restricted. Trade secrets were closely guarded and played as trump cards by the men in case of disputes. England was being strangled, and Germany was beating her in the markets of the world.

Nor were the employers guiltless. In fact, it is the Engineering Record's deliberate opinion that they, not the employees, were primarily responsible for England's industrial decadence. By and large, they did not pay a living wage, and they persistently held to the exploded doctrine that low production costs are to be attained by low wages. They did not recognize that insanitary working conditions, insanitary housing, underfed employees cut down production. They cared nothing for the condition of the worker. Under those conditions the worker had no reason to be interested in the success of the employer. The employer was not interested in him.

Furthermore, scientific research, scientific study of production processes were almost unknown (the word "almost" might with justice be omitted) in British industry. Consequently new methods were not being introduced which would so increase production as to permit of the better payment of labor.

Then came the war, and both sides have been forced to see their errors. The restriction of output of the men was shown up glaringly. On the other hand, the low production was found by government supervisors to be due, also, to the underfed condition of the workers and to impaired vitality caused by insanitary surroundings in home and shop, the underfed condition and the deplorable housing, of course, being attributable to the less-than-a-living wage. Also came the revelations regarding the neglect of research by the industries, which stamped England's industrial leaders as living in the spirit of a past age.

How much of the improvement made as a result of these discoveries will be permanent only the future can answer. The probabilities are that—though not without stress and strife—the higher wages and the better working conditions will persist, that scientific research will go forward in every industry.

Now, how stands the matter with us? Do we need awakening industrially? The answer is "Yes"; and though war will be a stiff price to pay for the awakening, we may as well accept the byproduct and take it as some compensation for the sacrifices we shall have to make.

We are, of course, not as badly off as England was. Yet in this country, too, the Engineering Record holds, the employer must take a new point of view with reference to his employees. Much of the present dissatisfaction, as indicated especially in the railroad labor situation, is due to the obtuseness of the employers. They have not dealt broadly with the human factor. The treatment, generally speaking, has been such as has been forced by the workers.

Again, we have much to learn regarding the place of research work. The metal and chemical industries have made good progress; the others, with here and there exceptional plants, hardly any.

If war comes, a new light may break for both employer and employee. Already, as a result of handling European war orders, many plants have learned how to double and treble output—and note that the wages are high. If now our own government enters the market on a large scale she will undoubtedly set about standardizing as England did, with the result that the deficiencies of employer and employee will be shown up.

The Engineering Record does not hold this will be the only compensation. England and France, and, in a measure, Germany have had a moral awakening, and surely we need that too. That would be the greater good, but the engineer's province concerns the relations of employer and employee so directly that we have chosen to dwell rather on that one of the many compensations which the impending calamity is likely to bring to this nation.

Fishing Creek Station Develops 44,000 Horsepower Under 50-Foot Head

Timber Forms for Concrete Intakes and Scroll Cases Built as Separate Units—Gates Operated by Wire Ropes on Drums

WHEN, on Nov. 21, 1916, the first power was turned out of the new Fishing Creek plant of the Wateree Power Company, located about 3 miles north of Great Falls, S. C., it marked the successful completion of a station containing five units of the single-runner vertical type developing 8800 hp. each under about 50 ft. head. Outdoor-type transformers and a steel-frame switching structure were used to decrease cost, while at the same time affording better switching arrangements. In the construction of the dam and the power house, both built of cyclopean concrete, the forms for concrete scroll cases, intakes, draft tubes and the fifty sand gates were rapidly built in separate units in the carpenter shop and yard located below the power house. Other special features include the use of wire rope and drum hoists for operating gates and the rack framing of an arch type claimed to effect large economy.

The Fishing Creek station is one of three new plants of the Southern Power Company located on the same watershed of 4000 square miles drainage area—the Lookout Shoals plant completed about one year ago, the Fishing Creek plant just put into operation, and the Bridgewater station, for which two 15,000-hp. units have already been purchased. The features which especially distinguish the Fishing Creek plant will here be considered. It is of interest to note that the scroll cases for the Lookout Shoals plant are of riveted steel, those for the Bridgewater plant of cast iron, and those at Fishing Creek of reinforced concrete. The reason for these differences is that the Fishing Creek plant has only a 50-ft. head, while Lookout Shoals and Bridgewater have 85 ft. and 135 ft. respectively.

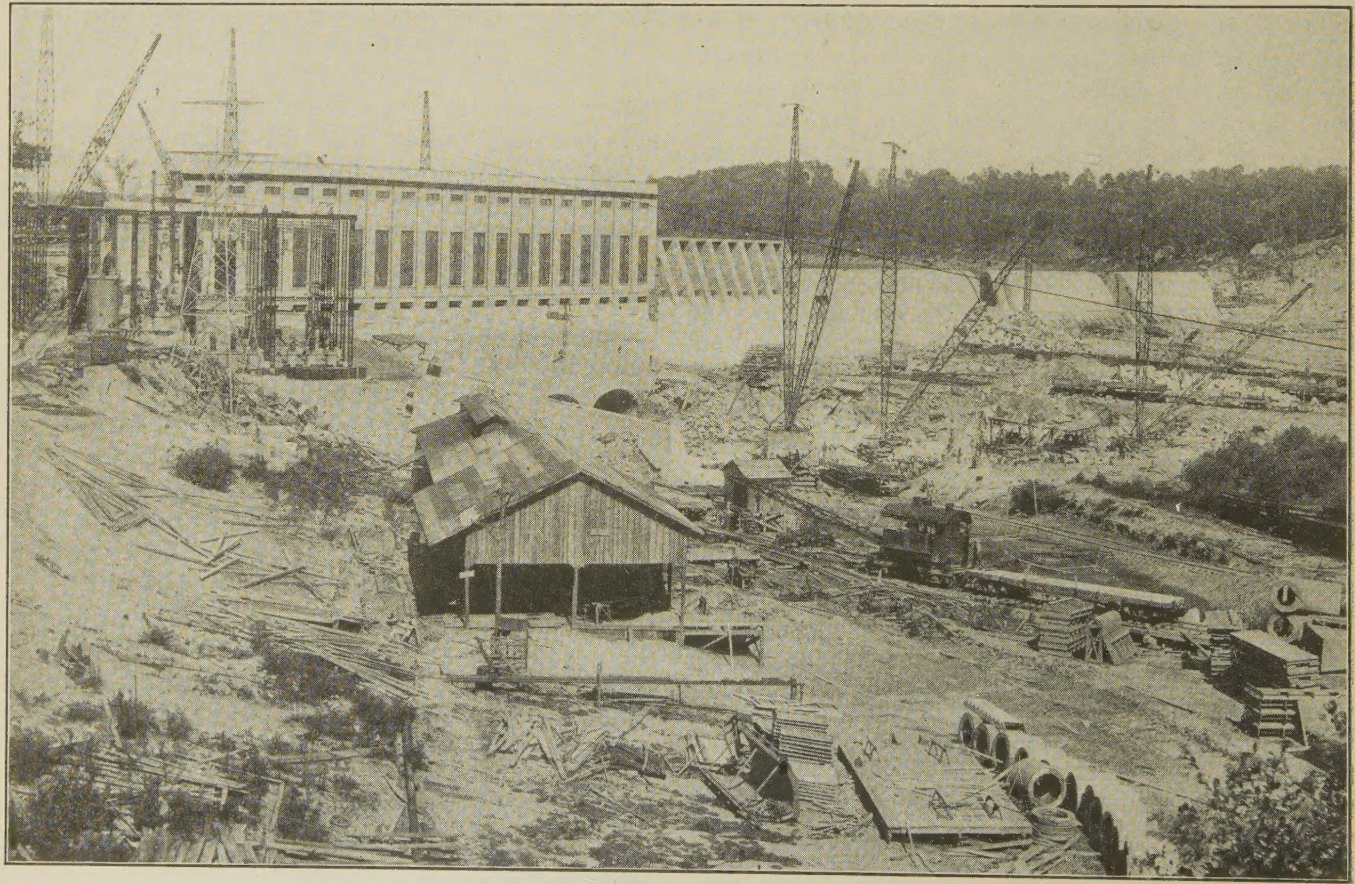
GENERAL DIMENSIONS

The total length of the dam and power house is 1800 ft., with 1130 ft. of spillway section—a dam 48 ft. high proportioned as shown in a drawing herewith. The twelve flood gates, each 10 ft. wide, are located next to the power house, which is 255 x 60 ft. in plan. Thus the total additional width of flood-water area is 120 ft. and at maximum high-water level a total of 350,000 sec.-ft. is estimated as the available waterway, including that over the spillway section.

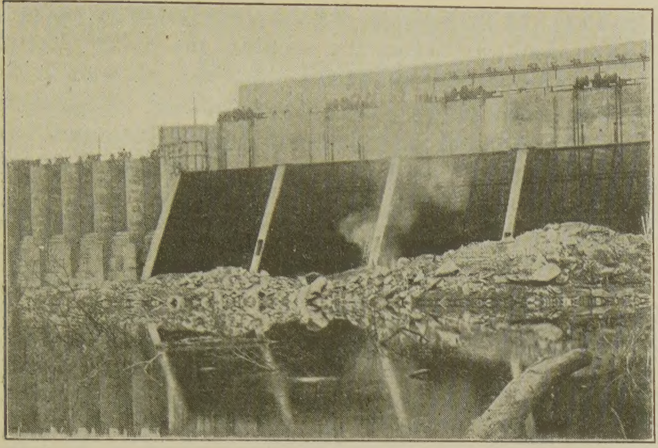
At normal level the dam creates a pond about 4½ miles long and impounds about 20,000 acre-feet.

DESCRIPTION OF TURBINES

Each unit is a single-runner vertical turbine rated at 8800 hp. at 97 r.p.m., coupled to a 6600-volt 6000-kw. generator, with individual exciters mounted above.



PROGRESS VIEW ON OCTOBER 1—CARPENTER SHOP AND YARD IN FOREGROUND FOR BUILDING UNIT FORMS



FLOOD-GATE AND HEAD-GATE HOISTS ABOVE RACKS

Water governors are used. Each unit requires 17 gal. of filtered oil per minute, furnished by a gravity system. To handle the machinery an 80-ton electric crane is installed on the runway shown in the cross-section of the power house.

Following the usual practice of the engineers of the Southern Power Company, of which the Wateree Power Company is a subsidiary, the turbines were first purchased, thus definitely fixing the dimensions for the concrete foundations, intakes, scroll cases, draft tubes, etc., of the power house, the construction of which is always begun first to insure the completion of the generating plant by the time the dam is closed. In this way power can be turned out immediately after such closure is made. Generators, switchboards and all electric equipment are also purchased early, thus fixing all power-house details, including ventilation passages, etc., at the time the first design is made.

REINFORCED-CONCRETE SCROLL CASES

One of the distinctive features in the construction of the power-house foundations is the construction of the reinforced-concrete scroll cases by the use of timber forms placed as units on prepared concrete bases, clearly shown in the photographs and in the front-cover picture. By concentrating all the carpenter work in a shop and yard a short distance below the power house, rapid construction of the forms was attained and the units were easily handled at the site by derricks. In this way the placing of cyclopean concrete and the 1-in. square rod reinforcement was greatly facilitated.

As indicated in the photographs, the construction of the power house and dam was carried out by the use of guyed derricks of 115-ft. masts and 100-ft. booms, made by the Minneapolis Steel & Machinery Company. The derricks were built on timber cribs, and cofferdams above and below the site were constructed of similar timber cribwork filled with rock and puddled with clay.

POWER HOUSE AND SPILLWAY

The general dimensions and the relation between the power house, flood gates and spillway section are indicated by the photographs and drawings, the power house being at the north end of the dam. The bottom of the flood gates is 10 ft. below the crest of the dam, and the gates can be raised to a level of the crest of the spillway, thus furnishing a flexible control for the head acting on the turbines.

One of the interesting features of the dam is the installation of special cups at the rock foundation and connected by pipe lines to the longitudinal inspection gallery. By means of these cups it is planned to measure the water pressure under the dam and obtain valuable data regarding the amount of uplift.

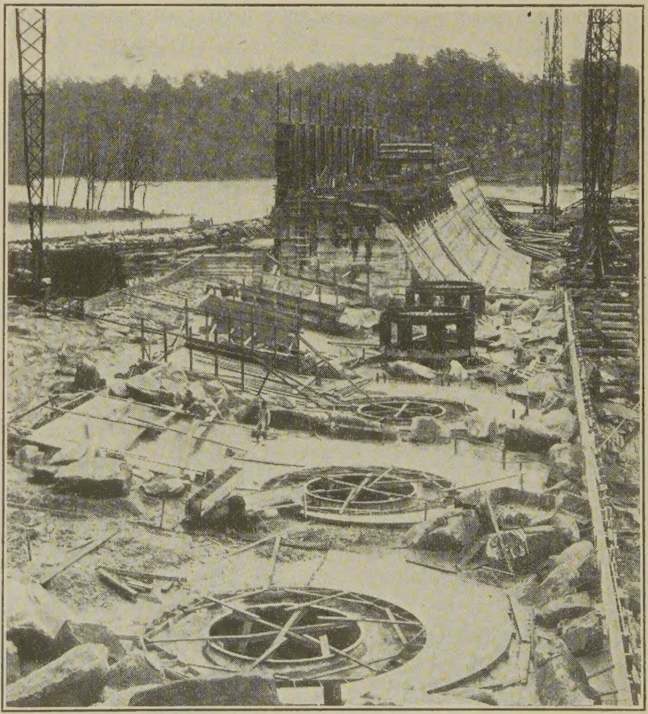
Another feature is the use of fifty so-called sand gates, or 4-ft. passageways, through the dam for the purpose of cleaning the bottom of silt, etc. They also act as diversion channels for the water of the river during construction and closure. These are indicated in the cross-section of the dam.

GATES OPERATED BY WIRE ROPES

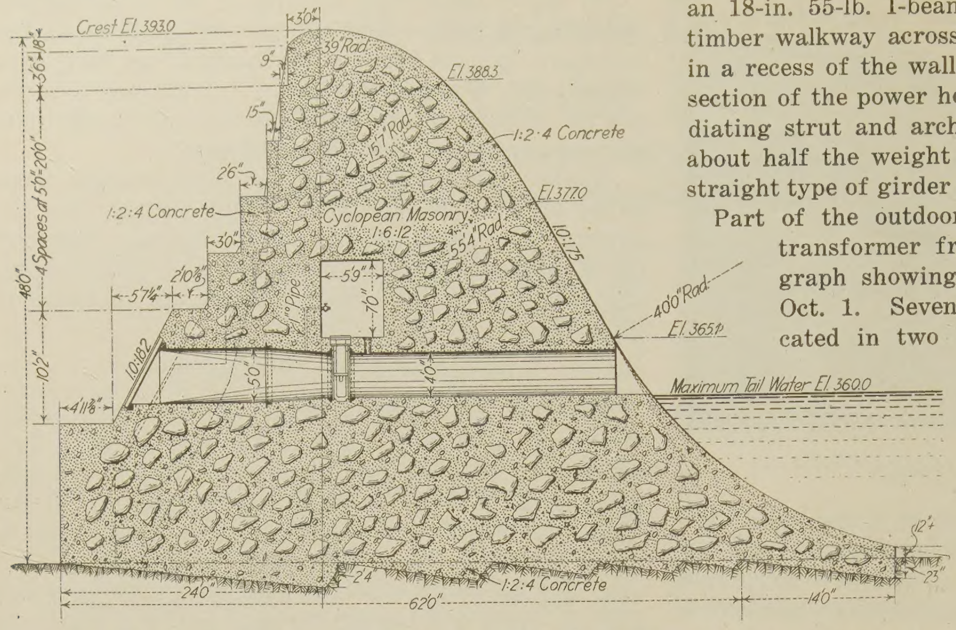
Both the head gates and the flood gates are operated by special mechanism designed to raise or lower them by ¾-in. wire ropes and 14-in. sheave blocks. The head gates are 21 x 27 ft. in size, of steel frame construction, filled with concrete, and weighing 216,000 lb. total in air or 156,000 lb. when immersed. A double drum operates the rope cables attached to these gates at two points 13½ ft. apart and passing through 5-sheave blocks and equalizers. The drum shafts are geared to a long shaft driven by a 75-hp. motor near the center of the group of five units.

The flood gates, each 10 x 14 ft. in size and about 22 in. deep at the center, are built of steel frames sheathed on the face by 3-in. planking and 1-in. tongue-and-groove rough oak lagging. They are raised and lowered around the hinges at the lower edge by two ¾-in. wire ropes attached at the outer or downstream edge and operated by drums on shafts geared to a longitudinal shaft driven by a 75-hp. motor near the center of the group. One of the photographs shows the operating mechanism viewed from the upstream side of the power house. In this picture the gate racks are seen, and behind them the special frame supports.

One of the drawings, in connection with the cross-



PLACING POWER-HOUSE UNITS—CONCRETE BASES FOR SCROLL-CASE FORMS



CROSS-SECTION OF SPILLWAY—1:6:12 CYCLOPEAN CONCRETE FACED WITH 1:2:4 MIX

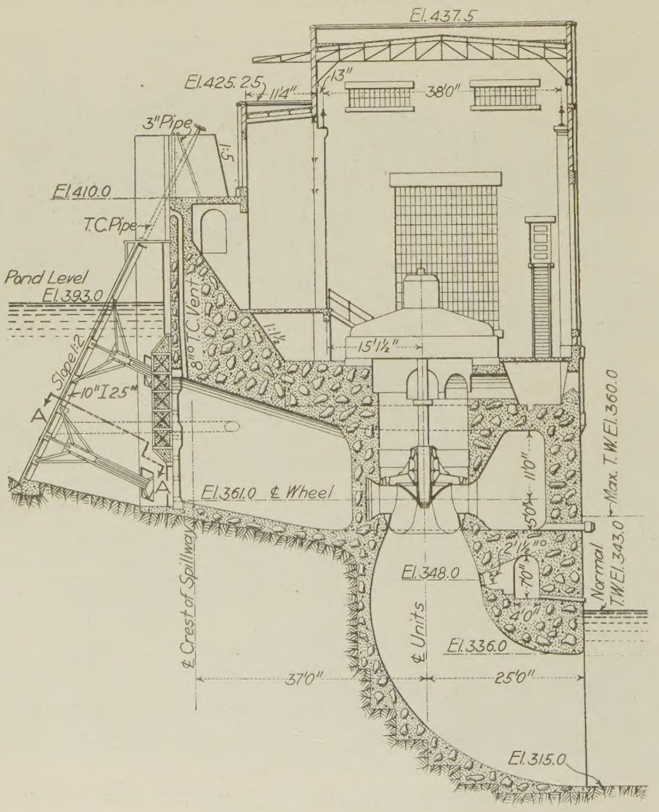
section of the power house, indicates the special framing used to support the racks designed to protect the intakes. These racks, about 42 ft. square, are designed to resist full water pressure. Instead of straight girders between the side walls there is used an arch type of framework with radiating struts to support the face beams at proper intervals and carry the thrusts to the concrete walls at each side. Two of these arch frames support each rack, and the struts are carried both laterally and in a vertical plane properly to support the facing 10-in. I-beams. These beams are of varying span lengths, increasing toward the top as the water pressure decreases.

The upper ends of these face beams are supported by an 18-in. 55-lb. I-beam, with a bent plate to carry a timber walkway across the opening, the planks resting in a recess of the wall at the other end, as seen in the section of the power house. It is estimated that this radiating strut and arch type of support contains only about half the weight of metal required for the usual straight type of girder or beam support.

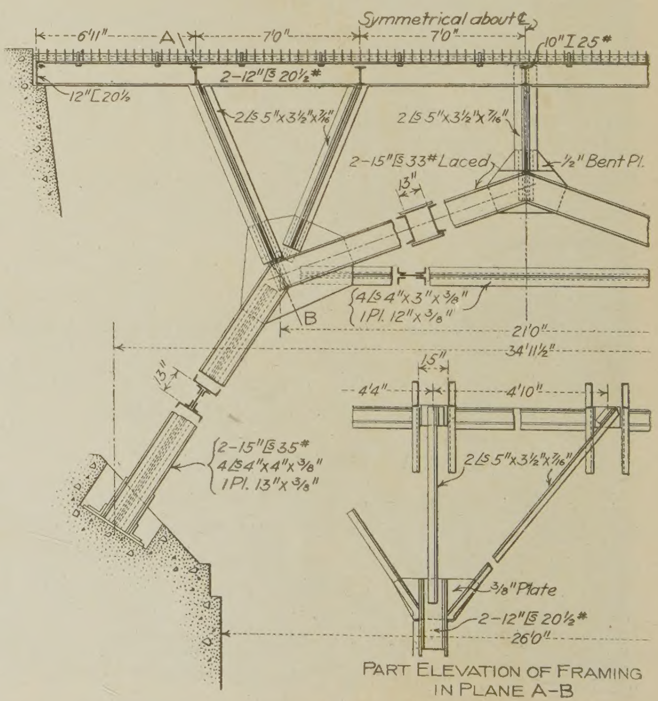
Part of the outdoor steel switching structure and transformer frame can be seen in the photograph showing the completed power house on Oct. 1. Seven 5500-kw. transformers are located in two banks of three each, with one spare, to transform the 6600-volt current as generated to 100,000 volts for transmission. Two circuits and transmission lines are provided to Great Falls and two to Salisbury, N. C.

The outdoor type of transformers and switching structure was used to eliminate the necessity for expensive housing and at the same time afford a better arrangement of the switching at a lower cost than the old indoor type. Furthermore, fire risk is practically eliminated.

The contract for this work was let in May, 1915, the first turbine unit was set in January of this year, the power-house foundation was completed in June, 1916, and final closure of the dam made on Nov. 16, 1916. The contractor was the Hardaway Contracting Company, Inc., of Columbus, Ga. The turbines are from the S. Morgan Smith Company, of York, Pa., and all the electrical equipment was furnished by the General Electric Company, of Schenectady, N. Y. The design was worked out by C. A. Mees, designing engineer, and construction was under the direct supervision of A. C. Lee, assistant chief engineer of the Wateree Power Company, a subsidiary of the Southern Power Company, of Charlotte, N. C.



CROSS-SECTION OF POWER HOUSE AND LOCATION OF GATE RACKS



PART SECTION AA—FRAMING FOR GATE RACK SUPPORT

Colleges Should Humanize Courses in Engineering

Nelson P. Lewis Advocates the Introduction of More Cultural Studies and Emphasizes Importance of Ability to Write

MAINTAINING that courses in our engineering schools should be liberalized by the introduction of more cultural studies, Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City, in a paper presented Dec. 28, 1916, to Section D of the American Association for the Advancement of Science at its annual convention in New York, advocated modifications in technical-school curricula whereby a major group of engineering subjects would be supplemented by a thorough course in the English language and literature, a good training in, not a smattering of, one other modern language, and courses in history, economics and the law of contracts. Mr. Lewis would follow such a program even at the expense either of eliminating some of the subjects considered to be essential in present-day engineering courses or of adding a year to college courses. Trained under such a plan, Mr. Lewis believes, graduates would reflect far greater credit upon their schools than they have done in the past. To the general subject of English and the writing of clear, concise reports Mr. Lewis often reverted. He said, in part:

IMPORTANCE OF WELL-WRITTEN REPORTS

"Engineering was formerly believed by the average citizen to be little more than a trade. The engineer's function was conceived to be the planning and carrying out of what others may have concluded to be necessary and expedient. Those who determined what was to be done seem to have felt it to be the duty of the engineer to do things when he was told, as he was told and because he was told. For a long time the engineer himself appeared to acquiesce in this conception of his functions.

"These were the conditions which prevailed within the memory of most of us, but they do not exist at the present time, except possibly in some branches of the public service, municipal, county, state and even federal. No financial concern engaged in floating bonds for private enterprises will now undertake to handle such securities until they have had a report from competent engineers as to the soundness of the project, including not only its engineering feasibility but its probable earning capacity and the market for its output, whether that be power, light or any manufactured product. Such reports, if they are to carry conviction, must not only be technically sound, but they must be orderly in arrangement, clear and concise in the presentation of facts, arguments and conclusions, and must bear upon their face evidence of the absolute confidence of the writer in the accuracy of his facts and deductions.

"Further than this, the engineer must frequently present verbal explanations and arguments to the promoters or to a board of directors before the enterprise is undertaken, as well as during its progress, if he is charged with its execution. Many reports resulting from thorough and painstaking investigation fail of their purpose because the subject matter is not presented in an orderly manner and the conclusions are not clearly and concisely expressed. Often, too, when the engineer is called before a board of directors and asked for further information the impression which he makes is an unfavorable one, due chiefly to the use of poor English and the self-consciousness which comes from lack of practice in speaking.

THE $30,000 MAN

"The head of a large industrial corporation, who was also the chairman of a board of trustees of an engineering school and was urging the broadening of engineering education, put the case in this way: 'We can get plenty of men who are technically competent, who are careful and thorough in their investigations, whose conclusions we know to be sound, but who cannot make a favorable impression before a board of directors. We can get plenty of lawyers who, after being coached by our engineers, can glibly and even convincingly talk to this same board of directors until some question is asked which has not been covered in the process of coaching, when they too will flounder about. If we can secure a man who possesses the conscientious thoroughness and accuracy of the engineer and also has the facility of expression and persuasiveness of the lawyer, what is a salary of $25,000, or $30,000, to us for such a man?'

"He therefore urged that this particular school, instead of trying to turn out a large number of $2,000 to $5,000 men, give to the profession a limited number of $25,000 to $30,000 men.

STUDIES FOR PROFESSIONAL CAREER

"What kind of studies are best calculated to fit a man for such a professional career? Let us say that the purpose of his training should be to insure: (a) Honesty and accuracy in his reasoning; (b) the habit of thoroughly testing his conclusions, in order that they may be not only the logical, but the inevitable, result of his premises; (c) clearness and simplicity in his presentation of both premises and conclusion; (d) orderly and logical arrangement of both, so that they may readily be followed by those to whom they are addressed.

"Personal honesty and high professional ideals are, of course, essential to true success in any occupation, but the course of training in these subjects should begin before a boy is born, and we are considering only his professional training after the high-school period.

"The study of mathematics should induce accuracy in thought and work. An error cannot be tolerated and will inevitably be discovered in the solution of a mathematical problem which, if properly checked, will prove itself. Such reasoning, however, is conducted through the medium of formulas and equations which are not understood by the layman, for whose benefit they must be converted into ordinary language.

"It will be futile to urge that engineering degrees should be given only as the result of a post-graduate course open exclusively to those presenting arts degrees. What we may properly insist upon is that the courses in our engineering schools be liberalized by the introduction of more cultural studies.

"It is quite probable that familiarity with the classics, supplemented by a thorough course in one's own language and literature, with a fair knowledge of one other modern language, will greatly enrich one's vocabulary, but all of this is not needed to enable an engineer to write an intelligent report or to address a board of directors. It is not necessary that a report dealing with an engineering subject should be expressed in the language of a Howells or a James, nor will its force and that of its conclusions be lessened by the occasional use of a split infinitive or through the employment of a phrase that might give pain to some purists. It will, however, be much more forceful if expressed in simple but virile language, the habitual use of which can be acquired only by the reading of the best literature.

MODIFY PRESENT CURRICULA

"Why should not our engineering schools so modify their curricula as to insist upon a major group of engineering subjects, supplemented by a thorough course in the English language and literature, a good training in, not a smattering of, one other modern language, and courses in history, economics and the law of contracts? But, the technical school men will say, we would not have time to do this unless we shorten or omit some of the courses which we believe to be essential to an engineering education or add another year to our course. Then let them adopt one or the other of these courses, and it is quite probable that the records of their graduates would reflect greater credit upon these schools than they have in the past.

"It is unfair to young secondary-school graduates, it is unfair to the engineering profession, to confine their further education to strictly technical courses. Extend these courses to five years, if necessary, in order to introduce the liberal studies which have been referred to, giving credit to those who present degrees from reputable colleges, so that they may complete the strictly technical work of the curriculum in four or even three years. In other words, it is time that those who are responsible for the training of engineers realized that they are fitting men for one of the learned professions and that this cannot properly be done unless the curriculum is humanized."

Road Costs in Illinois Analyzed

A careful analysis of the cost of all Illinois state-aid roads built to date indicates that 18-ft. concrete pavements have been constructed for $1.16 per square yard, and those 10 ft. wide at $1.23, excluding the grading and bridges. Brick costs 60 cents more. The average excavation per mile, said B. H. Piepmeier recently in a report to the Illinois Society of Engineers, has been 4500 cu. ft., costing $1300. For concrete culverts, 10 ft. and under in span, $525 was paid.

Investigation of maintenance figures shows that the expense of installing transverse joints is usually sufficient to cover all maintenance expense on cracks for a period of eight to ten years, and it is further noted that there is practically no difference in the maintenance expense on a pavement that has none. Careful investigation indicates that there is a considerable reduction in longitudinal cracking of concrete pavements when the transverse joints are omitted.

Federal Road Funds Apportioned

Sum of $10,000,000 Allotted for State-Aid Construction Work During Fiscal Year Ending June 30, 1918

THE federal appropriation for the fiscal year ending June 30, 1918, of $10,000,000 to aid the states in the construction of rural post roads has now been apportioned among the several states by the Secretary of Agriculture in accordance with the terms of the Federal-Aid Road Act. Before making the apportionment, the Secretary, in accordance with the provisions of the act, deducted 3 per cent of the appropriation, or $300,000, to meet the cost of administering the act. The remaining $9,700,000, has been divided among the states as the act prescribes—one-third in the ratio of area, one-third in the ratio of population, and one-third in the ratio of mileage of rural-delivery routes and star routes. Apportioned on this basis the money is divided as follows:

APPORTIONMENT OF FEDERAL-AID ROAD FUNDS FOR YEAR ENDING JUNE 30, 1918

State	Sum apportioned
Alabama	$208,297.80
Arizona	137,027.04
Arkansas	165,378.20
California	302,127.84
Colorado	167,380.28
Connecticut	62,180.88
Delaware	16,368.74
Florida	111,952.54
Georgia	268,658.96
Idaho	120,927.00
Illinois	441,852.46
Indiana	271,495.24
Iowa	292,351.20
Kansas	286,414.80
Kentucy	194,943.82
Louisiana	134,949.32
Maine	96,903.00
Maryland	88,094.44
Massachusetts	147,701.90
Michigan	291,567.44
Minnesota	284,788.12
Mississippi	177,811.68
Missouri	339,440.82
Montana	196,574.38
Nebraska	213,541.62
Nevada	128,796.60
New Hampshire	41,993.24
New Jersey	118,425.36
New Mexico	157.475.62
New York	501,440.54
North Carolina	228,763.84
North Dakota	152,286.12
Ohio	373,810.84
Oklahoma	230,278.00
Oregon	157,374.74
Pennsylvania	461,288.34
Rhode Island	23,331.42
South Carolina	143,615.28
South Dakota	161,892.04
Tennessee	228,306.96
Texas	583,855.62
Utah	113,900.30
Vermont	45,688.94
Virginia	199,321.42
Washington	143,768.56
West Virginia	106 540.92
Wisconsin	256,722.14
Wyoming	122,393.64
Total	$9,700,000.00

This is the second apportionment to be made under this act. For the fiscal year ending June 30, 1917, the appropriation was $5,000,000. For succeeding years the appropriation is as follows:

1919	$15,000,000
1920	20,000,000
1921	25,000,000

These sums do not include the $1,000,000 which is appropriated each year for ten years for the development of roads and trails within or partly within the national forests.

Chicago's Half-Completed Garbage-Reduction Plant Turns Expense Into Income

Col. H. A. Allen Tells of New Control Unit, a Five-Yard Box, and of Offense Elimination by Non-Carbonization and "Petticoat" Stack Diffusers

EXPENSE has been turned into a substantial income at the Chicago garbage-reduction plant, and at the same time the operations are carried on without offense. Many new ideas have been worked out by the technical staff of the city; and although it has been expensive to rebuild a new plant on the restricted area and to keep the old plant working inoffensively, the unit costs per ton have steadily decreased each year since the city acquired the plant in 1914, and this year a profit of 87 cents per ton is expected. Some of the more interesting engineering features—such as the design of a new collection box, the new "petticoat" stack for commingling the drier gases quickly with the air, the concrete cyclones, and the difficulties encountered in building a new plant on top of an old one—were described Jan. 19 by Col. H. A. Allen, consulting engineer for the city of Chicago and chief of waste-disposal technical staff, before the Chicago chapter of the American Society of Mechanical Engineers. From this paper the following extracts are taken:

During the bad weather of February, 1914, instructions were issued to start the work of rehabilitating the old plant purchased from the Chicago Reduction Company. This necessitated working night and day on the design and construction, both being carried on at the same time. By June the plant began to handle all the garbage of the city in a practically inoffensive manner.

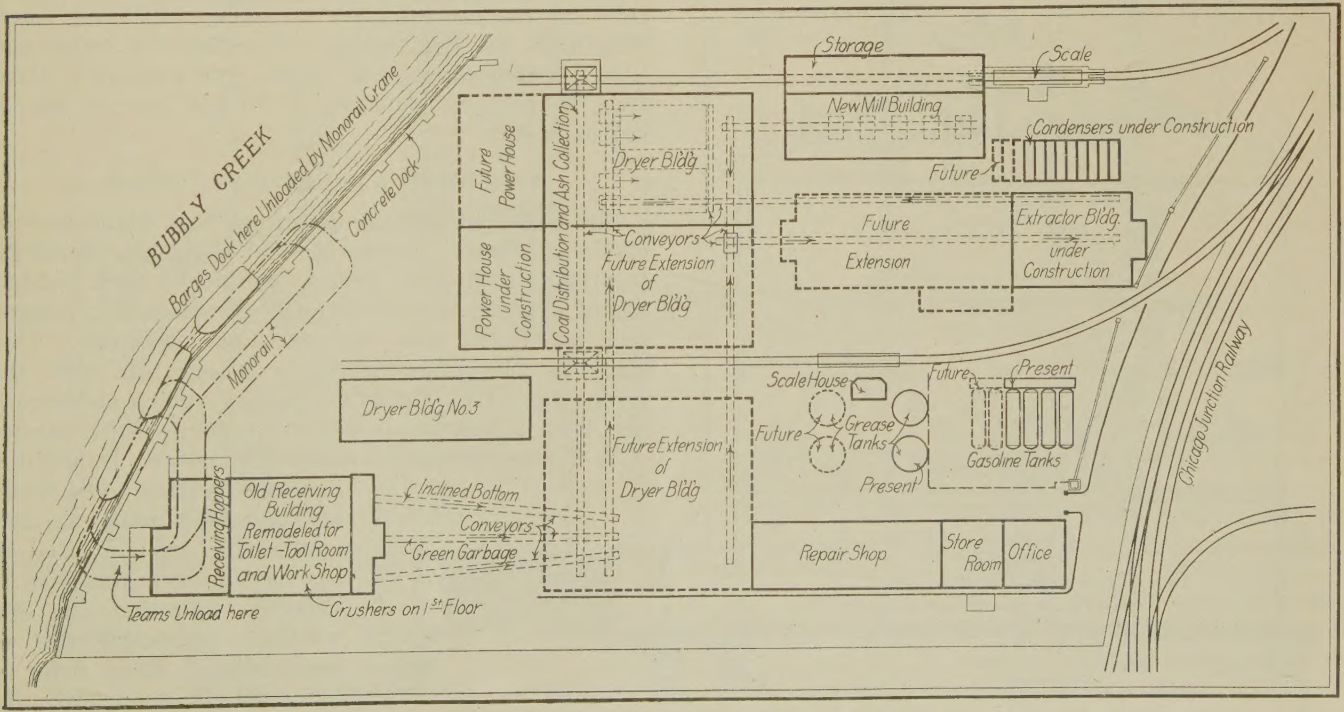
One of the greatest difficulties in disposal problems is the location of loading stations and plants; or, more strictly, the securing of permission for sites. While the citizens appreciate the necessity for disposal plants. they prefer to have them near their neighbors' rather than their own backyards. Hence, locations are too often acquired by political expediency rather than by good engineering judgment.

The women of Chicago, through their various organizations, have played a most important part in bringing about the solution of the city's waste question, especially as regards garbage. These organizations are of invaluable assistance in educating the householders properly to separate and take care of household wastes.

The city of Chicago approached the question in a broad-minded and business-like way, appropriating requisite funds for investigations, studies and experiments.

COLLECTION UNIT SELECTED

To facilitate this work all along the line, from the production of waste to the point of final disposal, a unit was selected. The most difficult phase of the entire problem is getting the garbage from the kitchen to the collecting unit. It was for this reason that the garbage box was selected. The larger the capacity of this unit, other things being equal, the less the cost of collecting and handling. Study showed that a 6-cu. yd. box when filled became too heavy for a two-horse team except on the best of paved streets. As only 13 per cent of the alleys in Chicago and 62 per cent of the streets are paved, this prohibited such a large unit being used throughout the city. The 5-yd. unit adopted consists of a box 12 ft. long, 4 ft. wide and 32



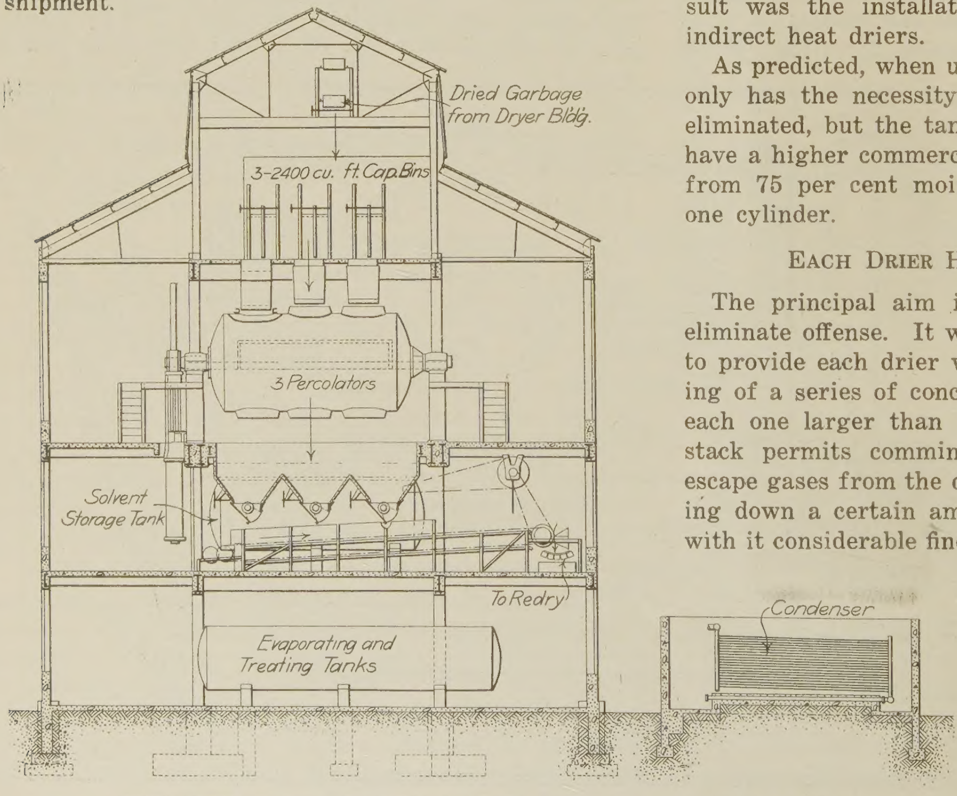
CHICAGO MUNICIPAL REDUCTION PLANT AS IT WILL BE WHEN ALL NEW STRUCTURES ARE BUILT in. high, as shown in one of the illustrations. Two such boxes can be loaded abreast, three in length and two vertically, making twelve boxes per specially designed railway car. One-half of this number can be loaded on a specially designed street car. The net load of garbage contained will be approximately 34 and 17 tons respectively.

By adopting a standard collecting unit it is possible at loading and disposal stations to standardize hoisting equipment, including cranes, runways and slings; hauling equipment, including wagons and tractors; and transporting equipment, including railways and electric cars, steam and tow barges.

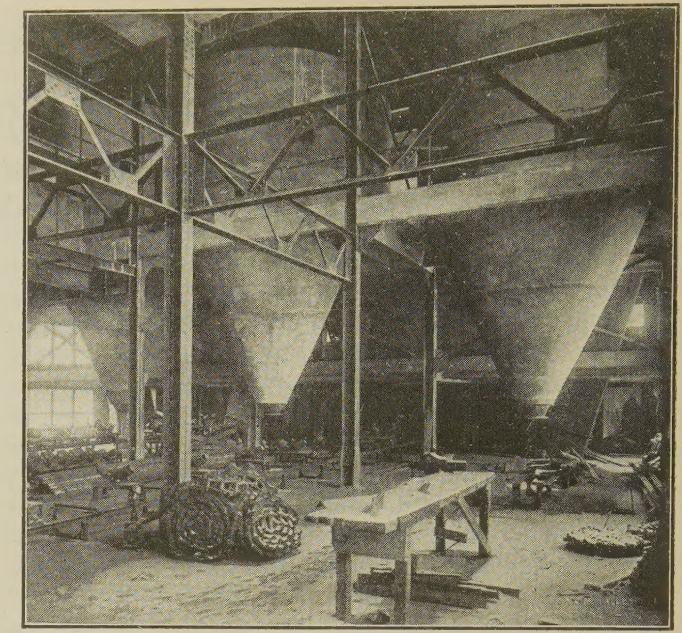
The studies so far conducted indicate that the following may be considered an axiom: That system of handling an offensive substance is the most sanitary, least offensive and, in general, commercially the best which exposes the least or fewest surfaces to contact with such substance.

DRIER PROCESS SELECTED

In the drier process of reduction in use at the Chicago plant the garbage is generally first run through a crusher to smash open cans of condemned foodstuffs and to break up other large material for more efficient drying. The material from the crusher is then fed into driers, its moisture content being reduced to 10 per cent or less. From the driers it is fed into percolators, where it is subjected to the action of a grease solvent. The grease-saturated solvent is drawn off, the solvent distilled off and condensed for repeated use, the grease being treated and stored for shipment. Steam is then turned on to drive off any residual solvent, after which the tankage, containing about 26 per cent moisture, is withdrawn and put through final driers to reduce the moisture content to from 6 to 8 per cent. It is then screened, milled and screened, and stored ready for shipment.



EXTRACTORS HAD TO BE BUILT UP INTO THE AIR TO CONSERVE SPACE



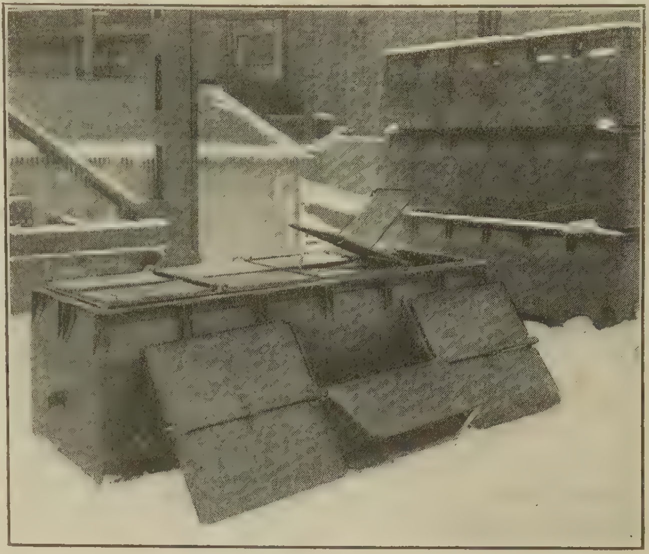
SMOOTHLY FINISHED CONCRETE CYCLONES HAVE GLASS PEEK HOLES

This system was one of the first employed, but in most cases has been replaced by the cooking process, or the latest modification of it, the Cobwell system. Colonel Allen's investigation convinced him that one great cause for offense at the plant of the Chicago Reduction Company was due to the use of direct-heat driers and consequent burning or carbonizing of certain greases and materials, such as hair and flesh. It would seem that certain offensive gases so formed are not soluble in water and therefore are not readily washed or scrubbed. This scorching action, he holds, was not only the cause of offense but also the cause of loss in the amount and value of byproducts. The result was the installation of the more costly direct-indirect heat driers.

As predicted, when using the indirect-heat driers not only has the necessity for scrubbing practically been eliminated, but the tankage and grease are better and have a higher commercial value. The garbage is dried from 75 per cent moisture to 10 per cent or less in one cylinder.

EACH DRIER HAS "PETTICOAT" STACK

The principal aim in designing this plant was to eliminate offense. It was thought advisable, therefore, to provide each drier with a "petticoat" stack consisting of a series of concentrically placed steel cylinders, each one larger than the preceding lower one. This stack permits commingling of outside air with the escape gases from the drier, thereby cooling and throwing down a certain amount of moisture which carries with it considerable fine suspended matter. In addition it causes dilution. The stacks are provided with suitable sprays for use in case of any possible emergency due to delayed collection in hot weather, accidental fire or overloading. Each drier is arranged in the newly designed drier building as a



NEW COLLECTION UNITS WILL STACK ON BARGES OR CARS

The eight-section cover in place is the one chosen. The stiffened sides eliminate obstructing cross-braces. The rectangular trunnion, grasped by a motor-actuated chain hanger at disposal plant, permits a controlled rotation of the box.

practically complete unit, having its own cyclone and "pettioat" stack.

The cyclones are made of reinforced concrete, about 3 in. thick, with the bars in the cone hooked over a circular beam at the junction with the cylindrical portion. An extremely smooth, plastered surface was obtained by treating the surface with a scratch coat and finishing smooth with a rich mix cement mortar.

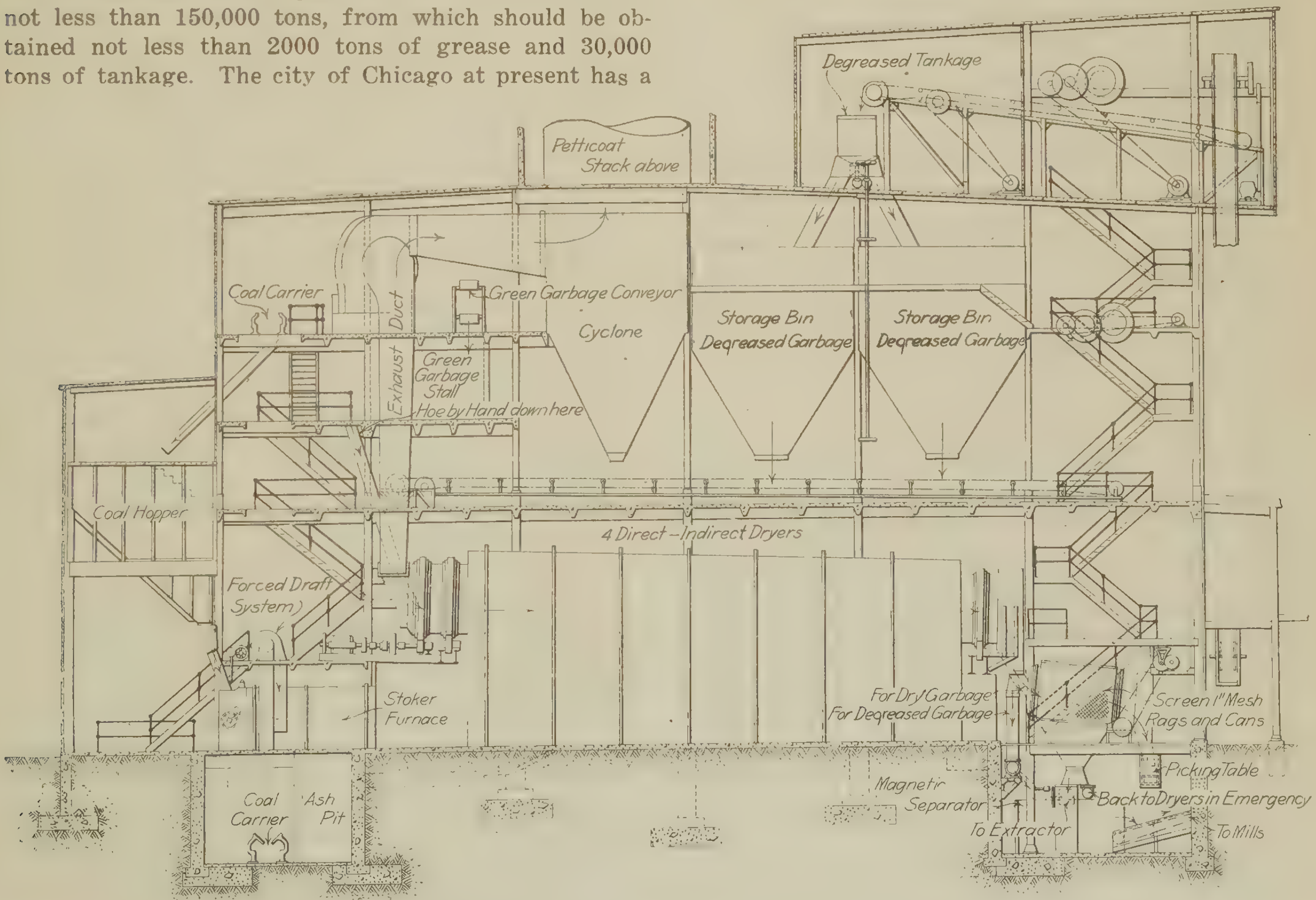
Profit Expected This Year

The net costs of the disposal of garbage to the city since the old plant was acquired average 48.2 cents per ton. In 1914 the cost was 76.8 cents; in 1915, 63.2 cents, and in 1916, 16.1 cents. The estimated profit in 1917 will be 86.9 cents, when it is expected 145,000 tons will be handled. The cost of handling will amount to $477,000, but will produce a revenue of $603,000. In this estimate the price of grease has been taken at 5 cents per pound and tankage at $5 per ton, both figures much below present market prices. During 1916 the extractor plant operated only from June on and the mill house was not in full operation until the latter part of the same month.

From Jan. 1 to the time of starting the extractor plant the city received only $3.27 a ton for commercially dried garbage, which is green garbage dried down to 10 per cent moisture. The capacity of the old mill house was not sufficient to handle all garbage degreased, necessitating the storage of approximately 14,000 tons on the property north of the plant, thereby greatly increasing the cost of production of tankage.

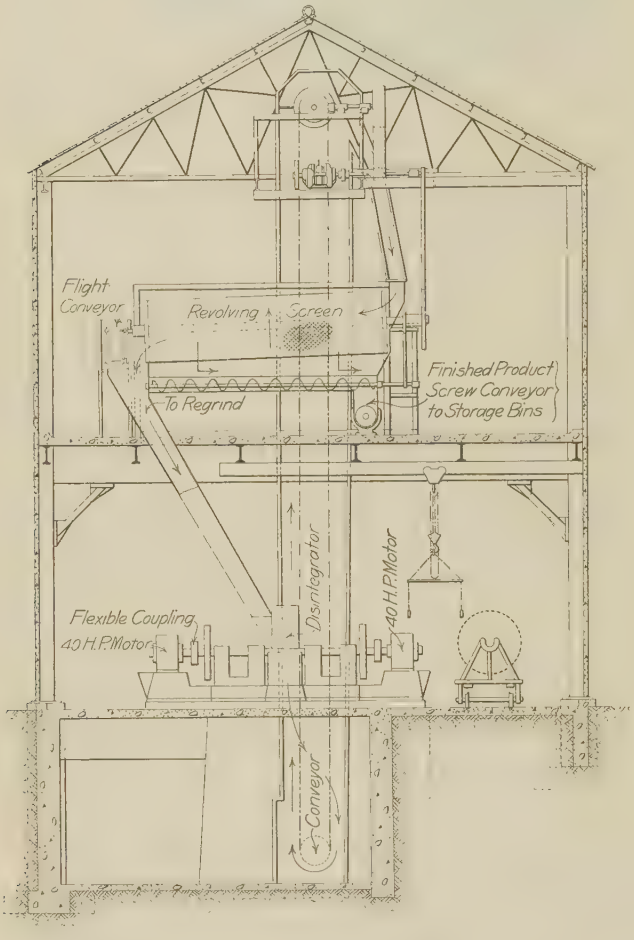
Colonel Allen estimates the amount of garbage that will be delivered to the plant during the year 1917 at not less than 150,000 tons, from which should be obtained not less than 2000 tons of grease and 30,000 tons of tankage. The city of Chicago at present has a contract for the purchase of garbage grease at a price of 7.29 cents per pound on a basis of 3 per cent unsaponifiable, total impurities not to exceed 6 per cent. The city has a contract for the purchase of garbage tankage at the sum of $4.16 per ton. The price received for the grease is high, but that received for the tankage is low, the present market value of garbage tankage exceeding $7 per ton.

Garbage comes to the plant by barges on Bubbly



LONGITUDINAL SECTION OF NEW DRIER HOUSE

Creek, an arm of the Chicago River, and by team, the boxes from both being unloaded by a monorail crane in use now for more than a year. In winter the boxes are dropped for a few minutes into a thaw tank of boiling water kept hot by steam coils. Designs for new steel barges include arrangements to heat the boxes en route with exhaust steam. Had a new site been available a plan would have been worked out whereby the boxes could be dumped directly into the driers, thus saving handling; but the old plant, with its receiving hoppers, crushers and button conveyors to the driers, had to be maintained while construction went ahead. As operated now the green garbage goes first to old drier house 1, where are located six American Process Company oil-burning driers, which reduce the moisture from 70 or 80 per cent down to 30 per cent. A portion of the green garbage, however, goes to drier house 3, where two newly installed Atlas indirect coal-burning driers reduce the moisture at once to 10 per cent. The first portion mentioned goes from No. 1 to drier house 2 to be reduced to 10 per cent through two old direct-indirect oil-burning driers. The 10 per cent material from Nos. 2 and 3 then goes to the old extractor plant for degreasing. About 20 per cent of moisture is added here in the steaming process in the seven tanks. As the new mill house has been completed, the degreased tankage goes to it after having the rags removed, and another drying to 10 per cent takes place in the old apparatus. Within a few months new drier house 4 will be completed and the green garbage will go direct from the button conveyors to it, thence to the new percolator house, back again to No. 4 to be redried, then to the new mill building.



TWO-STORY MILL HOUSE HAS SIMPLE LAYOUT

NEW DRIERS DIRECT-INDIRECT TYPE

The four new 100-ton Atlas driers are of the direct-indirect type, heated to low temperatures, so as not to scorch the material, by coal furnaces equipped with automatic stokers. Exhaust fans pull the moist air to the fourth floor and discharge it into the cyclones. On this floor are located the green garbage conveyors which dump into bins on the third floor, providing a small storage for short delays. From here the garbage is hoed by hand down a chute into the mouth of the drier. At the far end is located a rotary screen to remove rags, cans and large material to a picking table. Banana stalks, grape fruit and other large objects are carried back to be crushed and returned to the drier. The material passing the 1⅛-in. mesh screen goes to the percolators, from where it is returned to be stored until sent again through one of the four Atlas driers.

Provision is made frequently to break the continuity of the material so that a fire cannot train back any distance. The driers are equipped with sprinklers should the contents be fired, and provision is made for returning the material again to the mouth of the driers.

DUST A MINIMUM IN MILL BUILDING

When passed through the driers the second time the tankage goes to the mill house. The disintegrators are driven by 40-hp. motors, right and left-hand drive being connected at either end, thus eliminating belting. As the disintegrator machinery must be replaced often, a special mounted cage and crane are provided. After screening, the tankage is sent by screw conveyors to the stack houses located over the shipping track. The oversize, with the fluffy material eliminated, is returned to the mills.

An intricate vacuum system reduces the dust nuisance in the grinding room to a minimum. A mechanical device in the suction on the filters lets the pressure off and on for stated periods while the filters are agitated. All motors are inclosed, and a vacuum constantly removes dust from the rotating parts.

The appearance of the extension of the new buildings, which are of steel-frame construction, with walls of plastered metal lath, metal sash and roofs of Federal cement tile, has been given special attention, with the idea of reducing any actual or imaginary odium attached to such a plant. The street end of the extractor building is made ornamental with a pressed-brick tower, serving the double purpose of a fire wall and an outside concrete stairway to the street.

Fire Hose to Clean Sewer Pipes

The city of Brawley, Cal., is effectively using a home-made nozzle on a 2½-in. fire hose for cleaning out small sewer lines, according to G. R. Wade, city engineer. The nozzle consists of a fire-plug cap perforated with seven or eight ⅜-in. holes and attached to the end of the hose. A pressure of about 50 lb. keeps the hose stiff enough so the nozzle can be pushed ahead from manhole to manhole. The amount of water escaping through the perforations is sufficient to clean out the silt which has heretofore frequently given trouble.

Organized Labor and Business Must Accept Equal Obligations

Inevitable Conflict Must Be Met So as to Conserve the Interest of the Public, Says Harry A. Wheeler

THAT organized labor has now reached a point of national accountability and that it must be controlled by the same laws which are applied to the regulation of organized business was the contention of Harry A. Wheeler, in an address delivered Feb. 1 before the fifth annual convention of the Chamber of Commerce of the United States at Washington, D. C. His subject was "Industrial Relations" and his remarks are given below:

"I do not hope that you will agree with all of my statements, and I am certain that the labor group will not approve. Nevertheless as I may be able I shall hold up to you certain conditions with language as naked as I know how. My purpose is to speak not in defense of organized business or in condemnation of organized labor, but rather to interpret by an honest analysis of the situation why the great neutral public touched neither by the indignities put upon business by certain groups of organized labor nor by a sympathy with labor in its sometimes real, but often imaginary, grievances against organized business will not countenance any return to 'strong-arm' methods, but will insist upon the recognition of mutual rights and that the contest shall hereafter be carried on with full realization on both sides of the rights of the third and neutral party.

CAPITAL AND LABOR

"Reviewing the conditions which now confront us as a nation, arising from abnormal industrial activity, fictitious prices, false values and reckless extravagance, and looking forward to the conditions which will obtain when the world resumes its domestic tranquillity is the relationship which shall exist between capital and labor and which we are accustomed to call our labor problem.

"If a serious and unprejudiced study of the subject is undertaken, we are faced with such a wealth of argument from both sides, each giving evidence of deep sincerity and supported by illustrations so appealing that the mind becomes confused with the mingled and contradictory proof and logic, that we feel inclined to cast aside all of the arguments and to endeavor to hold the subject up, not for complex scientific analysis, but rather that the simple sense of right and justice may be applied to this most complicated relationship of our economic existence. Unless we do this we are sure to find that we are chasing the scientific solution to the utter forgetfulness of the human elements which neither law nor regulation nor force can harmonize.

A CONDITION, NOT A PROBLEM

"First, then, that which we call a problem is not at all a problem, but a condition. If it were a problem we might hope by applying the science of law or of economics to find a solution. Or if this relationship could be reduced to a matter of conduct, controlling laws or regulations or customs could be evolved and commonly accepted, as in all of our other social relationships. It is a condition because it is a contest between two groups of human beings charged with responsibilities which conflict, surrounded by influences which develop opposite mental conditions and with points of view difficult indeed to focus upon a point of common interest.

"It is a meeting point of two living forces, the one having the purpose to hold, the other to get; a contest which began with the birth of the race and which will continue to the millennium.

"The second point is closely related to the first, namely, that there will not be, and we should not expect, a complete adjustment between these two forces, capital and labor, whereby co-operation will replace the periodical struggles for advantage.

"Julius Henry Cohen of New York in a recent article on the revised protocol in the dress and waist industry so well expressed the point which I have in mind that I wish to use his words:

"'There seems to be a rather current belief that there is presented to employers to-day a clear choice between peace and war. This is a fundamental error made by nearly all critics of the protocol. The fact is that as long as we live and for a longer period still we shall have conflict in industry. We shall not have peace. The real choice is not between peace and war, but between conflict and conflict. Or, put it another way: the question is, how shall inevitable conflict be met so as to conserve the best interests of all parties concerned?'

BUSINESS LEADS THE WAY

"My third point is this: Since the differences which enter into our industrial relations are fundamentally human, and since the conflict is destined to continue, it is logical that it will be carried on by both sides with increasingly efficient organized forces. Business has led the way in teaching the advantages of organization as it has in every other development in our industrial and social life. The old time units of production and distribution which the individual owned and controlled united with other similar units in the partnership. These later took the form of corporations in order that there might be greater freedom from individual liability and less interruption of operations when changes in interests became necessary or desirable. Corporations linked themselves into combinations for economic advantage. Lines of business organized into local, national and trade groups. The business and professional interests of whole cities joined hands for the commercial and civic advantage of united action and finally all of these united in this organization under whose auspices we are now meeting, yet no one will be bold enough to declare that, from first to last, any of these organizations had for their primary purpose or for their purpose at all the betterment of the other group to this discussion.

BENEFITS OF ORGANIZATION

"What benefits have been secured as a result of organizing business? We all know in our own city the answer to this question and will bear witness that the multiplied forms of organization have not only been the result of necessity but have brought safety, efficiency and harmony out of danger and waste and senseless warfare. What wonder that having the example furnished by organized business this other group should do likewise? The only wonder is that the organization of this group should not have been more rapid.

"In 1910 of the estimated 27,000,000 wage-earners only 8 per cent of the whole were members of labor organizations. Or if deductions are made of all occupations which do not readily lend themselves to organization, the percentage would be 18.4 per cent of the potential possibilities. In 1910 trade unions had 2,116,317 members; in 1914, 2,674,000 members; and to-day probably close to 3,000,000, or 10 per cent of all wage-earners and more than 20 per cent of the potential possibilities. The value of organization in the field of labor is as obvious to labor interests as in the group of organized business and as in the case of organized business the primary purpose is only to serve its own interest.

DAY OF ORGANIZED FORCES

"The point is that we are living in a day of organized forces. Individualism has been relegated to the rear. We think and act through the group, and organization in the field of labor will move forward with rapidity in times like the present and with slight loss in times of depression but with the certainty that each decade will witness a marked increase in the number of trades or vocations organized and with a larger per cent of each trade in the union ranks.

"My fourth point is: If we concede that we are confronted by a condition of natural opposites; if the conflict must continue, and if it is to be directed by organized forces of increasing strength, then in the interest of national safety these forces must come under some measure of control, for while the law may be powerless to harmonize conflicting human relationships, it can and must control the operations of known forces that, if allowed to continue without restraint, will trespass upon public rights and affect the public welfare.

REGULATORY LEGISLATION

"Organized business has sown its wild oats and has been chastised by the legislative rod. If it shall henceforth hold itself in check against a return of its own shortcomings; if it shall honestly endeavor to live with contending forces, rather than attempt ruthlessly to destroy them, then it will become the basis of a new governmental program and of a new economic life.

"Organized labor is passing through comparable stages. Its program is more simple than that of organized business and lends itself to greater unity of action. Its purpose is wholly selfish. To achieve its aim it gives no consideration to the effect of its acts upon public convenience or public welfare. Its program is better wages, shorter hours, better working conditions. The program suits as well the laborers on the Pacific Coast as on the Atlantic and comprehends the desires alike of laborers in the lumber camps of the West, of the cotton mills of the South and the steel mills of the East. Its driving force is votes; its goal, exemption from interference by law or regulation with any act which may advance its program. Its purposes are gained by force or threat of force, and in the exercise of that force some of its units have sinned grievously against society and most of its units, when in action, have committed acts for which the law would severely punish the private individual. Its weapon—the strike—may not be denied it when the effect is only upon an employer or group of employers in the same business or upon a very limited portion of the public, but organized labor has shown itself not content to halt its combination of units with the trade or community, and as in the railroad situation last summer, and later in the traction strike in New York, both supported by frank expressions of approval from the American Federation, its purpose was to extend the area of its activity to nation-wide limits if necessary. Surely as this policy is continued the public will rise and demand protection against such an abuse of power and such utter disregard of the rights of society.

LABOR DISREGARDS PUBLIC WELFARE

"Organized labor has not yet seen a vision of its responsibilities to the public; it has not yet felt the weight of the legislative rod, but it is destined to encounter both public and legislative correction for any persistent exhibition of arrogance, ignorance or brutality of which it may be guilty and it may be that such correction and restraint must be administered before answer is to be made to Julius Henry Cohen's question: 'How shall inevitable conflict be met so as to conserve the best interests of all parties concerned?'

"Why is it that in the consideration of these two organized forces a clear legislative distinction is drawn between them in their relation to government and their accountability to society? Some of you may answer that it is because the individual element in the membership of one of them, with its supposed powers of swift and certain retaliation, has been more considered than the acts of the organized force itself. I am not willing to contend that this is not a factor of more than ordinary importance, but I should prefer to find another reason and to set it up for consideration even though it be less logical. It is this: Until recently the force of organized labor has not come to the point of national action and therefore of national accountability whereby a continuance of present exemptions in the face of a power to inflict national harm would constitute a monumental blunder. When organized forces, no matter how composed, become equal in the sphere of their activities, in their numerical strength and in their power to inflict injury, they must be controlled by the same laws and must share alike in the obligation to uphold the rights of all.

"At the outset I stated that I did not know that I should bring you a single final conclusion but it would seem that my conclusions are ready made for statement. In our industrial relations we are dealing with human nature, which we cannot change by force or by law. Conflict will persist because mental attitude and point of view cannot be adjusted to our present theory of co-operation. Highly organized forces are an economic necessity in the field of business, and organization which is permitted and encouraged in the field of business may not be denied or discouraged in the field of labor. Even the right to use the strike as the most potent weapon of organized labor must be acknowledged until that right encroaches upon the safety of the nation and the welfare of its people.

"Here a new national policy must be developed to which all organized force of whatever antecedents shall alike submit itself. In organized business legislative restraint and regulation has been applied rather harshly and often complaint has been justly made that its effect has been to retard development and to place us as a nation in an unfavorable competitive position. To-day the principle of regulation and restraint is recognized and accepted by organized business, and with the coming of the tendency honestly and earnestly to co-operate with the regulatory machinery of the government may slowly come public consent to modify the sweeping inhibitions of the law and permit larger co-operative action so long as a general welfare clause is consistently upheld and rigidly obeyed.

"In organized labor action heretofore has been within the trade or community or limited geographical area, but never nationally. Hence the necessity for national regulation has not been imperative. During 1916, however, organized labor laid bare its ultimate program. Four of its units or divisions made common cause to tie up the nation's transportation and thus paralyze every industrial operation. Although this act would have adversely affected other divisions or units of organized labor, protest was feeble, and by common consent all units not immediately involved stood by to watch the struggle. The result of this struggle is still a painful subject to this chamber, but it graduated organized labor into a force capable of nation-wide action and, therefore, placed it beyond the right to claim exemption from restraint. It also proved the unwisdom of Section 6 of the Clayton Law, under which in the face of a national conspiracy to inflict irreparable harm upon an entire people, no legal restraints were found available.

"This brings me to my last conclusion, namely, that the public interest as a third and now expressable interest in industrial disputes was born last summer and will hereafter demand its rightful voice in every national controversy. If the sanction, if the judgment of society, was for a shorter working day, how much more real is that sanction in the course of compelling public inquiry before action be taken interrupting the public service?

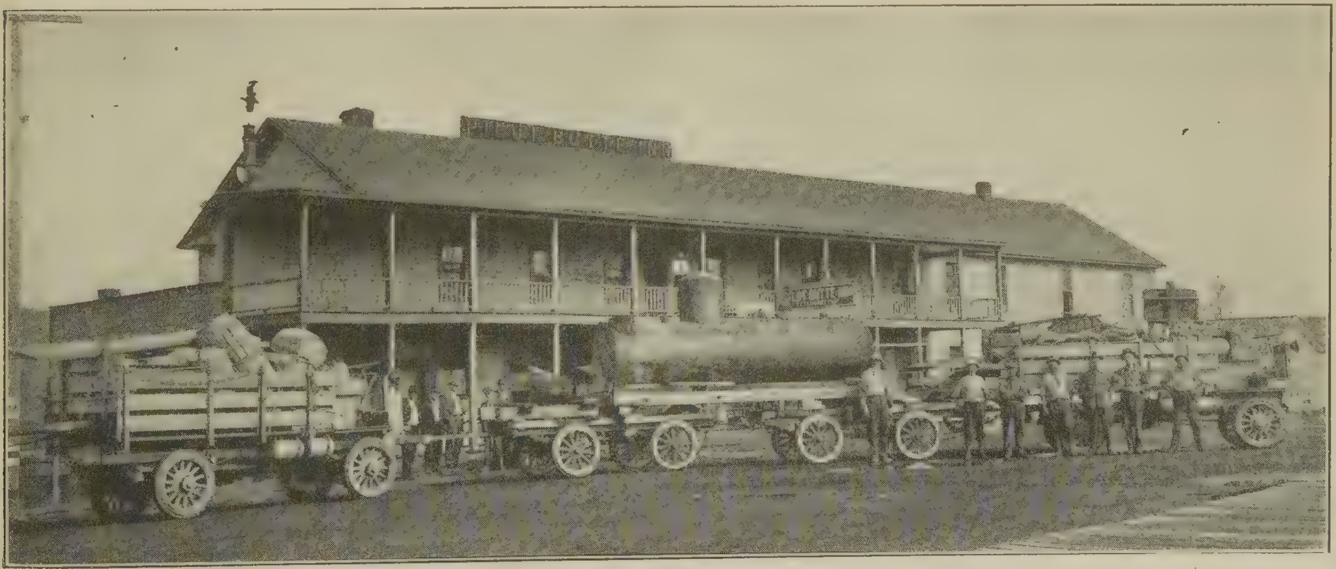
"I have tried nakedly and without bias to set forth the conditions with which we are confronted, as I see them. Never do I reach this point in the consideration of this subject that my mind does not fly back to Walt Whitman's words in urging affection as a cure for social ills: 'Were you looking to be held together by lawyers? Or by an agreement on a paper? Or by arms? Nay, nor the world nor any living thing will so cohere.' And it is so in the field of our industrial relations. Laws and agreements and arms may compel submission but will never win co-operation. And only as these two great economic forces of organized business and labor may come to accept the same measure of responsibility toward public welfare and to deal with each other not craftily but in a spirit of wholesome honesty and respect shall we approach the fount where 'inevitable conflict shall be met so as to conserve the best interests of all parties concerned.' "

"Double-Header" Motor-Truck Train Operates Across Desert

Trailers Used Between Motor Trucks in Handling Heavy Loads Over Bad Roads on 130-Mile Route in Oregon

A TRUCK-TRANSPORTATION company was recently organized for the purpose of hauling supplies from Bend across the desert to Paisley, Ore. The distance between the two terminals is 130 miles, chiefly through the desert, and part of the way over narrow, rough road with numerous 15-per cent grades, one of which is 2 miles long. An account of the truck problems recently appeared in the *Standard Oil Bulletin*.

Regular trips were made, hauling 3 tons to the truck and 2½ tons on a trailer, covering the distance between terminals in two days. On one occasion it was necessary to take in a 12-ton boiler. This was loaded on the two trailers, as shown in the photograph. These were coupled up with one truck ahead and one truck behind. The trucks themselves were each loaded to capacity, making the total freight on this trip approximately 16 tons. The trip was made without difficulty of any kind and on regular schedule time.



TWELVE-TON BOILER COUPLED BETWEEN MOTOR TRUCKS OPERATING OVER DESERT ROUTE

Advocates American Society Bureau for Engineering Services

P. M. Churchill, in Presenting Resolution Before Annual Meeting of Am. Soc. C. E., Gives Arguments in Favor of Radical Move

ONE of the most radical forward steps in the history of the activities of the American Society of Civil Engineers was advocated by P. M. Churchill, U. S. assistant engineer, Topeka, Kan., who offered a resolution at the annual meeting that a committee of three should be appointed to co-operate with other national engineering societies to formulate a plan for the systematic marketing of engineering services. The resolution, which on motion was referred to the board of direction for action, provided that the committee be empowered "to employ a competent, progressive engineer, if deemed advisable, to work out the details of such a plan." Mr. Churchill's letter, which was read by the secretary at the meeting, contains interesting criticism of the report by the committee on compensation of engineers (see Engineering Record of Jan. 13, page 68). This committee was appointed several years ago, following a motion by Mr. Churchill, who, in his letter, from which the following extracts are taken, presents arguments in favor of the plan:

COMMITTEE FAILS TO REPORT CONDITIONS

"I noticed in their report the committee says that it has never been able to determine what was intended by the portion of the motion referring to the 'condition of employment.' By this I intended that the proportion of lost time which the conditions of engineering work force on most engineers should be stated with the compensation received, in order that the real net income of engineers might be determined; furthermore, whether or not living expenses are allowed, travel expenses reporting to and returning from a piece of work were received, and other items which cut down the actual net receipts which finally decide the scale of living. I fully realize the difficulties in the way of obtaining this information, and it is partly for that reason that I have, in the motion just presented to you, provided for the employment of an engineer actually to handle the details of the work.

ENGINEER SHOULD BE BUSINESS MAN

"The engineer of to-day is or should be a business man, for otherwise a very large part of his technical skill will be useless simply because it will not materialize. But engineers have been slow to realize this and have often justified the criticism of their clients that they were all right for theory, but if you wanted anything accomplished you must get a business man to take charge of it. This opinion of the engineer has placed lawyers and merchants, and in fact every other kind of a man but an engineer, on the large commissions dealing exclusively with engineering work. The New York commissions and the former directors of the Port of Boston are sufficient examples of this. It is common to hear the appointing power say, 'We can hire plenty of engineers for the technical part, but we must have a business man to decide the policies of this commission.' We engineers individually can do little to counteract such tendencies, but the large national societies are in a position to secure a hearing when they speak, and so far that voice has been very feeble.

TO ORGANIZE ENGINEERING POWER

"In its larger features the motion I have just proposed is intended to organize the power of the great national societies, to make effective the large work of the engineering profession and to prevent its being crippled through the appointment of ignorant men to positions of power over engineering work. It is to provide machinery whereby the organized opinion of the engineering profession expressed through its national societies may quickly make itself felt when, for instance, a governor attempts to appoint on a commission having control of large engineering work politicians, lawyers, merchants, blacksmiths, etc.

"In its smaller features this motion intends to provide for working out the details of an engineering exchange where engineers may register their qualifications, file their credentials, and thereafter have the society furnish prospective employers with certified copies of these credentials, thus doing away with the present inadequate system of references which requires a new letter from former employers every time an engineer seeks a new job. It furthermore means that the agents of the society would watch the market and when it is learned that a community intends some development like a city waterworks it would inform the city authorities of the class of engineer required properly and economically to handle such work, of the salary necessary to secure a properly equipped man, and, if desired, would furnish a list of several such men who were available.

BARBERS AND WAITERS ELECTED COUNTY ENGINEERS

"Engineers requiring a force of men would have a reliable source from which to draw, which is not the case at present. It would prevent waste which now occurs in county work all over the country through ignorant supervision. I know of one county in one of the Middle States whose road and bridge work yearly amounts to several hundred thousand dollars, where in succession a barber and a waiter from a cheap restaurant have been elected county engineers, responsible for the design and construction of these works. These men after finishing their term of office have set up as consulting engineers and still further wasted the money of that community. This record can be duplicated all over the country, and the national engineering societies are directly responsible for the continuation of this condition.

"We are all familiar with these conditions. Most of us would like to see them remedied. We can only remedy them by concerted action, and such action should come from national societies."

Where Is the Money Coming From?

The revenue available for road purposes increased from $37.01 per mile in 1904 to $98.22 per mile in 1914—an increase of 165 per cent; while the actual financial burden upon the taxpayer increased in the same period from 23 cents to 35 cents per $100 assessed value, an increase of only 52 per cent.

Simple and Cantilever K-Trusses Analyzed

Part I—Formulas Derived and Influence Lines Drawn for Chord and Web Stresses and Applied to the Determination of Maximum Stresses

By C. L. WARWICK
Instructor in Civil Engineering, University of Pennsylvania, Philadelphia

THE essential feature of the K type of truss is the use of two main diagonal web members in each panel, arranged in such a way that the stresses are statically determinate. The consequent division of the shear results in lower sectional areas and less complicated details of web members and their connections than obtain, for example, in the Pratt truss with sub-panels; while it has the advantage over other types with two main diagonals in one panel, such as the double-intersection Warren truss, of being statically determinate. In view of these and other advantages, such as comparative freedom from secondary stresses and adaptability to economical and rapid erection, it may confidently be assumed that the K-truss will command wide attention among designers, especially for long spans, to which it is peculiarly adapted. The advantages of the K-truss and the reasons for its use in the Quebec Bridge are fully explained in a paper by Ralph Modjeski on "Design of Large Bridges, with Special Reference to Quebec Bridge" in the Engineering Record of Sept. 20, 1913, page 321.

ANALYSIS FOR PRIMARY STRESSES—ASSUMPTIONS

In the analysis which follows, the endeavor has been not only to develop direct, concise methods of determining the so-called "primary" stresses, but to emphasize those features which differ from the analyses of the usual types of trusses given in text-books on framed structures. Influence lines for stress are constructed, since these show most clearly the relation between stress and position of load and are very useful in discussing maximum stresses. The truss is first considered to act as a simple span, and the methods developed are then applied to a cantilever arm. These methods, however, are independent of end conditions and may be applied, for example, to a continuous girder after the reactions have been determined. As usual in problems dealing with influence lines, the stresses are computed for a single concentrated load of unit intensity moving over the structure.

The truss illustrated in Fig. 1 is similar to the anchor and cantilever arms of the Quebec Bridge. Although a truss acting only as a simple span would be symmetrical about its center line, it is convenient to use the same truss for both simple span and cantilever arm. Moreover, the anchor arm acts as a simple span under its own weight and loading. The following assumptions have been made in the interest of a general treatment:

1. That the points c′, e′, g′, etc., do not lie in the same straight line (in the Quebec Bridge they are in a line parallel to the grade line);
2. That such members as c′E, d′e′ and e′G are not parallel;
3. That the panels, and their divisions into sub-panels, are unequal in length; and finally,
4. That the slopes of the chords are unequal.

The analysis will be confined to the chord and web members in the panel EG, these being typical of the entire truss. The notation required is shown in Fig. 1. The values of OO_1, OO_2, and O_1O_2 are self-evident. The solution for z, the perpendicular distance from O_1 to e′G, is given in Fig. 1 (a). The value of z_1 follows by analogy.

Top-Chord Stress EG—Imagine the truss to be divided into two parts by section 1-1, Fig. 1, cutting five members, and forces to be applied at the ends of these members equal to the stresses in them before the truss was severed. These stresses and the external forces to either side of the section form a system of co-planar forces in equilibrium, and the algebraic sum of their moments about any point in their plane is therefore equal to zero. To find stress EG, moments should be taken about e, since three of the other four stresses, Ee′, e′e and eg, traverse e and are thus eliminated from the equation of moments. The fourth stress, d′e′, is evidently zero except when there is a floorbeam concentration at d′—that is, for loads in panel CE. The determination of stress EG may therefore conveniently be divided into two parts—(1) for loads outside of panel CE, in which case EG is the only stress in the moment equation, and (2) for loads in panel CE, in which case stress d′e′ enters that equation and must therefore be determined.

The first part presents a problem similar to that of the simple Pratt truss. Thus, with the unit load in any position from e′ to the right, at a distance x from the right support, the only external force to the left of section 1-1 is the reaction, R_a at a. Since stress d′e′ is zero, the algebraic sum of the moments about e of R_a and stress EG must equal zero. It will be more convenient to solve for the horizontal component, from which the stress itself may readily be found by multiplying by P'/P. Therefore resolve stress EG into vertical and horizontal components at E; the vertical component has no moment about e; the lever arm of the horizontal component is h. Then for loads from e′ to the right,

$$R_a \times r - \text{horizontal component EG} \times h = 0,$$

or since $R_a = \dfrac{x}{l}$,

$$\text{horizontal component EG} = \frac{x}{l} \times \frac{r}{h} \qquad (1)$$

In equation 1, x may have any value from zero to $l - r$. Stress EG is compressive, opposing the moment of R_a about e.

Similarly, by placing the unit load in any position from c′ to the left, at a distance x' from the left support, and taking moments about e of the forces to the right of section 1-1, the following equation is obtained:

$$\text{horizontal component EG} = \frac{x'}{l} \times \frac{l - r}{h} \qquad (2)$$

in which x' may have any value from zero to $r - P_1$.

For the unit load in panel CE—placed for convenience at d′—the value of the tensile stress d′e′ is i''/h_1, since the triangle d′e′e may be considered as a polygon for the forces at d′, the length e′e ($= h_1$) representing the unit load and length d′e′ ($= i''$) the stress d′e′. Expressing the moment of stress d′e′ about e as its horizontal component, p_1/h_1, multiplied by h_1, the following equation of moments of stresses and external forces to the left of section 1-1 about e may be written:

$$R_a \times r - 1 \times p_1 + \frac{p_1}{h_1} \times h_1 -$$

$$\text{horizontal component EG} \times h = 0,$$

or since $R_a = \dfrac{l - r + p_1}{l}$,

$$\text{horizontal component EG} = \frac{l - r + p_1}{l} \times \frac{r}{h} \qquad (3)$$

Equations 1, 2 and 3 may now be used to construct the influence line for the horizontal component of stress EG. Referring to Fig. 2 (a), ne and ac are graphs of equations 1 and 2 respectively. These lines may most conveniently be drawn by observing, first, that the intercept aa′ on line (2) of ne prolonged is r/h, the value of equation 1 for $x = l$; and second, that equations 1 and 2 are identical for values of $x = l - r$ and $x' = r$ respectively, so that ac prolonged traverses e. Next, lay off on line (4) the ordinate d′d equal to equation 3; then, since an influence line for any function is a straight line between successive panel points in the floor system, the lines cd and de complete the influence line across panel CE. But for $x = l - r + p_1$, equation 1 becomes identical with equation 3; therefore d must fall on ne prolonged. This is also evident from the fact that for any position of the unit load between e′ and d′ the moments about e of the load and stress d′e′ neutralize each other, thus leaving in the moment equation only R_a and stress EG, as in equation 1.

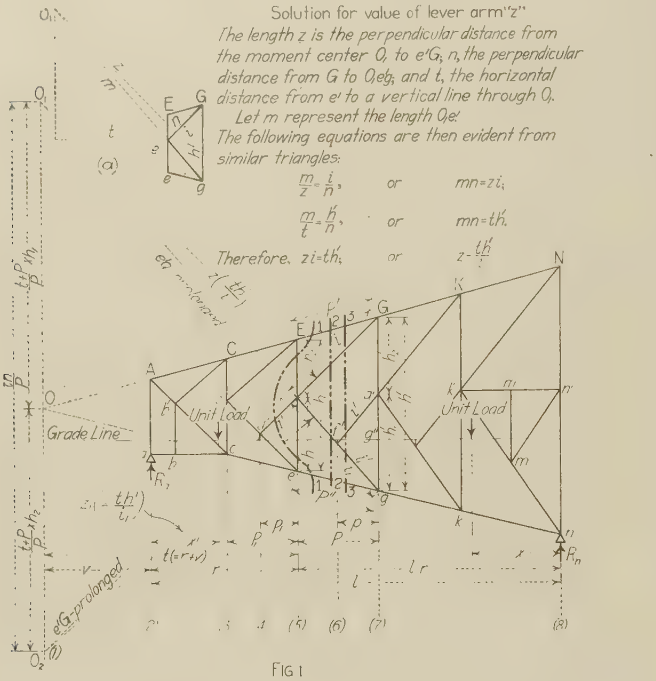

Solution for value of lever arm "z"
The length z is the perpendicular distance from the moment center O₁ to e′G; n, the perpendicular distance from G to O₁eg; and t, the horizontal distance from e′ to a vertical line through O₁.
Let m represent the length O₁e′
The following equations are then evident from similar triangles:
m/z = i/n, or mn = zi;
m/t = h′/n, or mn = th′.
Therefore, zi = th′; or z = th′/i
(a)
E
G
e
g
t
O₁
O
O₂
A
C
E
G
K
N
Unit Load
Unit Load
Grade Line
R₁
Rₙ
h
c
e
g
k
n
m
z₁ = th′/i₁
t(=r+v)
p
P
r
l
l r
e′G-prolonged
(3) (4) (5) (6) (7) (8)

FIG 1
Typical K-Truss, with Necessary Notation

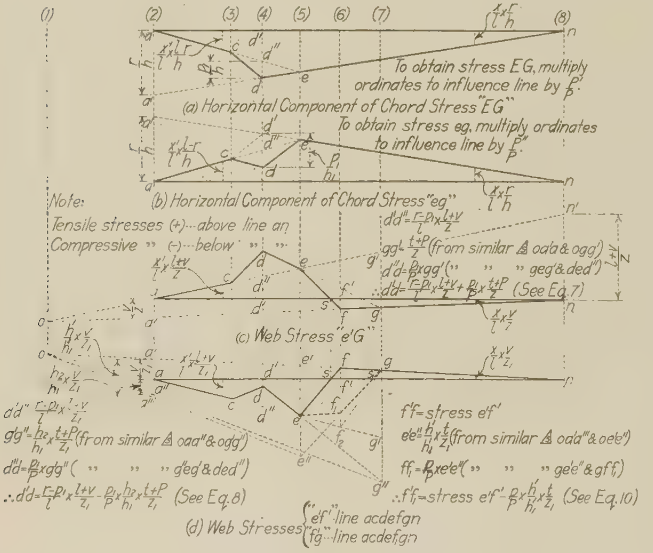

(1) (2) (3) (4) (5) (6) (7) (8)
To obtain stress EG, multiply ordinates to influence line by P′/p.
(a) Horizontal Component of Chord Stress "EG"
To obtain stress eg, multiply ordinates to influence line by P″/p.
(b) Horizontal Component of Chord Stress "eg"
x′/l × (l−r)/h
x/l × r/h
p₁/h₁
Note:
Tensile stresses (+)…above line an
Compressive " (−)…below " "
d′d″ = (r−p₁)/l × (l+v)/z
gg′ = t/z (from similar △ oaa′ & ogg′)
d″d = p₁/p × gg′ (" " " geg′ & ded″)
∴ d′d = (r−p₁)/l × (l+v)/z + p₁/p × (t+P)/z (See Eq. 7)
x′/l × (l+v)/z
x/l × v/z
(c) Web Stress "e′G"
h/h₁ × v/z₁
h₂/h₁ × v/z₁
x′/l × (l+v)/z₁
x/l × v/z₁
d′d″ = (r−p₁)/l × (l+v)/z₁
g′g″ = h₂/h₁ × (t+P)/z₁ (from similar △ oaa″ & ogg″)
d″d = p₁/p × g′g″ (" " " d′eg′ & ded″)
∴ d′d = (r−p₁)/l × (l+v)/z₁ − p₁/p × h₂/h₁ × (t+P)/z₁ (See Eq. 8)
f′f = stress e′f′
e′e″ = h′/h₁ × t/z₁ (from similar △ oa′a‴ & oe′e″)
ff₁ = p/P × e′e″ (" " " ge′e″ & gff₁)
∴ f′f₁ = stress e′f′ − p/P × h′/h₁ × t/z₁ (See Eq. 10)
(d) Web Stresses {"e′f′" line acdefgn / "f′g" line acdef₁gn

FIG. 2
Influence Lines for Stresses—Truss Acting as Simple Span

Influence Lines for Chord Stress EG

The complete influence line is acdn. If d′e′ were removed, the influence line would be acen, which is typical of the simple Pratt truss. Incidentally, this is the form of the influence line for stresses CE and ce in Fig. 1, since a section similar to 1-1 through these members traverses only four members—there being no member at c′ corresponding to d′e′. An ordinate between ce and cde, Fig. 2 (a), therefore represents an increase in the horizontal component of the chord stress EG induced by the secondary system in panel CE, the value of dd″ being equal to p_1/h. An analysis of stress EG of the sub-Pratt (Pettit) truss illustrated in Fig. 3 (a) leads to an influence line identical in form with acdn, the only difference being that here the secondary system which causes the increase in stress referred to above is that in panel EG, so that the triangle corresponding to cde, Fig. 2 (a), will appear in that panel, instead of in panel CE. A comparison of the secondary systems of the two trusses is given later.

Bottom-Chord Stress eg—Referring to section 1-1, Fig. 1, it is seen that the algebraic sum of the horizontal components of stresses EG, d′e′ and eg must equal zero, which furnishes a simple method of determining stress eg. Thus, with the unit load in any position outside of panel CE, stress d′e′ is zero, and the horizontal components of stresses EG and eg must be equal in magnitude and opposite in direction. Therefore equations 1 and 2 apply for the horizontal component of stress eg, which, however, is tensile instead of compressive. The corresponding influence lines are ne and ac, Fig. 2 (b), drawn as explained for Fig. 2 (a).

Stress for Unit Load at d′

With the unit load at d′, the horizontal component of stress d′e′ ($= p_1/h_1$) acts in a direction opposite to that of the horizontal component of stress EG, whose value is given by equation 3. Therefore

$$\text{horizontal component eg} = \frac{l - r + p_1}{l} \times \frac{r}{h} - \frac{p_1}{h_1} \qquad (4)$$

To complete the influence line, Fig. 2 (b), prolong ne to d′, and lay off d′d equal to p_1/h_1. Since the ordinate to d′ is equal to the first expression in the right-hand member of equation 4, the ordinate to d is equal to equation 4, and the complete influence line is acden.

The ordinates to this line must be multiplied by P''/P to obtain the value of stress eg.

The influence line for this stress is of different form from that for stress eg of the Pettit truss, Fig. 3 (a), which, since the latter member is unaffected by the secondary system, may be represented by acen, Fig. 2 (b). An ordinate between ce and cde therefore represents a *decrease* in the horizontal component of the chord stress eg induced by the secondary system, the value of d″d being equal to p_1h_2/h_1h; while it is evident that an ordinate between cde and cd′e at any point is equal to the horizontal component of stress d′e′ from a unit load at that point.

Thus it is seen that while in the Pettit truss the secondary system affects the stresses in only one chord system, in the K-truss both chord systems are affected, the stress in the top chord being increased and that in the bottom chord decreased. If such members as d′e′, Fig. 1, were arranged to act as struts instead of ties by being connected to the upper of the two diagonals, the effect would be to *decrease* the top and *increase* the bottom-chord stress. Finally, if the secondary systems in either truss are removed, the analysis reduces essentially to that of the simple Pratt truss.

WEB STRESSES

Diagonal Stress e′G—Imagine the truss to be divided into two parts by a vertical section 2-2 cutting four members, Fig. 1. To determine stress e′G, it is desirable to select, if possible, a moment center about which the algebraic sum of the moments of the stresses in the other three members cut will be zero, thus leaving stress e′G as the only unknown factor in the moment equation. O_1 is such a moment center for any position of the unit load outside of panel CE. This may be demonstrated as follows: As previously explained, for such a position of the load the horizontal components of stresses EG and eg are equal in magnitude and opposite in direction. Hence the resultant of these stresses must be a vertical force through their intersection O; this resultant and stress e′f′ both traverse O_1; therefore the sum of the moments of stresses EG, eg and e′f′ about O_1 is zero.

The stress in e′G for loads outside of panel CE may therefore be determined in exactly the same way as the stress in any diagonal web member of a Pratt truss with inclined chords, the only difference being that the moment center in the latter case lies at the intersection of the chords. Thus, for the unit load in any position from f′ to the right, letting x equal the distance from the right support, the compressive stress is

$$e'G = \frac{x}{l} \times \frac{v}{z} \qquad (5)$$

Similarly, for the unit load in any position from c′ to the left, letting x' equal the distance from the left support, the tensile stress is

$$e'G = \frac{x'}{l} \times \frac{l+v}{z} \qquad (6)$$

For the unit load at e′, stress d′e′ is still zero and equation 6 applies by substituting r for x'.

With the unit load at d′, consider that part of the truss to the right of section 2-2. Since d′e′ is now stressed, the horizontal components of stresses EG and eg are no longer equal, their algebraic sum now being equal to the horizontal component of stress d′e′ or p_1/h_1, as previously explained. The resultant of stresses EG and eg is therefore no longer a vertical force traversing O_1, but an *inclined* force through O whose horizontal component is p_1/h_1. The moment of this force about O_1, equal to its horizontal component multiplied by OO_1, must now be included in the equation of moments of forces to the right of section 2-2, which may be written:

$$e'G \times z - R_n(l+v) - \frac{p_1}{h_1} \times \frac{t+P}{P} h_1 = 0,$$

or, since $R_n = \frac{r-p_1}{l}$, the tensile stress is

$$e'G = \frac{r-p_1}{l} \times \frac{l+v}{z} + \frac{p_1}{P} \times \frac{t+P}{z} \qquad (7)$$

The influence line may now be constructed. Equations 5 and 6 are plotted in Fig. 2 (c) as nf and ac respectively. For convenient construction, note the familiar property that the intercepts aa′ and nn′ are equal, respectively, to v/z and $l+v/z$, showing that nf and ac prolonged intersect on the vertical through O_1. Prolong ac to e, and draw ef; s marks the position of a load for zero stress in e′G. Finally, prolong ge to its intersection d with the vertical line (4); the ordinate d′d is equal to equation 7, the proof of this construction being given in the figure. The complete influence line is therefore acdefn.

If d′e′ were removed, the influence line for stress e′G would become acefn, which is typical of trusses with single web systems, and, incidentally, is the form of influence line for stress c′E in Fig. 1, since there is no member at c′ corresponding to d′e′. Therefore the ordinates from ce to cde, Fig. 2 (c), represent the increase in stress e′G induced by the secondary system in panel CE, the value of d″d being equal to the last term in equation 7. For a K-truss without sub-panels the influence line would take the familiar form acegn.

Diagonal Stress e′f′—The moment center for this stress is O_2, and the analysis is similar to that for stress e′G. Thus, equations 5 and 6 apply by substituting z_1 for z and reversing the character of stress. The segments ac and efn of the influence line, Fig. 2 (d), require no explanation beyond noting that the intercept aa′ is here equal to v/z_1.

With the unit load at d′, the analysis leading to equation 7 may be applied to stress e′f′, O_2 being the moment center instead of O_1. Then the value of the compressive stress is

$$e'f' = \frac{r-p_1}{l} \times \frac{l+v}{z_1} - \frac{p_1}{P} \times \frac{h_2}{h_1} \times \frac{t+P}{z_1} \qquad (8)$$

To complete the influence line, measure $aa'' = h_2v/h_1z_1$, prolong oa″ to g″ and draw g″e to its intersection d with line (4); the ordinate d′d is equal to equation 8 as proved in the figure; or the last term in equation 8 may be computed and plotted directly as d″d. The ordinates from ce to cde represent the *decrease* in stress e′f′ induced by the secondary system in panel CE.

Diagonal Stress f′g—Stresses e′f′ and f′g are evidently equal except for loading in panel EG, which brings a floorbeam concentration at f′. Therefore the influence line for stress e′f′, Fig. 2 (d), applies to stress f′g except across panel EG; and the influence line for the stress f′g may be completed by determining the value of that stress for a unit load at f′.

For that position of the load, the triangle f′g′g, Fig.

1, may be considered as a polygon for the forces at joint f′, the length g′g representing the unit load. The force represented by gf′ ($= i_1'/h_1'$) is the resultant of stresses e′f′ and f′g due to that load. Stress e′f′ is tensile—equal to the ordinate f′f, Fig. 2 (d)—and stress f′g is compressive or tensile according as stress e′f′ is less or greater than i_1'/h_1'. The former condition usually obtains, and the following equation gives the value and sign of the stress:

$$f'g = e'f' - \frac{i_1'}{h_1'} \qquad (9)$$

It will be convenient to express i_1' in terms of z_1. Thus $i_1' = pi_1/P$, and $i_1 = th'/z_1$ (from the value for z_1, Fig. 1); substituting, equation 9 becomes

$$f'g = e'f' - \frac{p}{P} \times \frac{h'}{h_1'} \times \frac{t}{z_1} \qquad (10)$$

Now, since f′f, Fig. 2 (d), is equal to stress e′f′, if a point f_1 is found such that $ff_1 = \frac{p}{P} \times \frac{h'}{h_1'} \times \frac{t}{z_1}$ $f'f_1$ will equal stress f′g. Measure $a'a''' = \frac{h'}{h_1'} \times \frac{v}{z_1}$ prolong oa‴ to e″ and draw e″g; f_1 is the point of intersection of e″g with the vertical line (6). The proof of this construction is given in the figure. By using equation 10 rather than equation 9 to locate f_1, it is clearly shown that ef_1g is always concave upward, since e″ cannot lie above e; further, that e″g is a locus for point f_1 for various values of p, assuming panel point g′ fixed in position—that is, h_1' constant. The complete influence line is $acdef_1gn$; s_1 marks the position of a load for zero stress in f′g.

The influence line for the corresponding member of a Pettit truss—f′g, Fig. 3 (a)—takes the form acegn, Fig. 2 (d); that is, it is a straight line across panel EG, as distinguished from the broken line ef_1g for the K-truss. It is interesting to note, however, that ef_1g approaches the straight line eg as a limit if the point g′ in the K-truss is assumed to approach G, since then the ratio h'/h_1' approaches unity and e″ approaches e, Fig. 2 (d). In fact, to carry such a change in the K-truss to the limit of coincidence of g′ with G, e′ with E, etc., virtually destroys its identity, and reduces it to the Pettit type.

Sub-Diagonal Stress f′g′—This stress is zero except for loading in panel EG, and for a unit load at f′ its value (tension) is

$$f'g' = \frac{i'}{h_1'} \qquad (11)$$

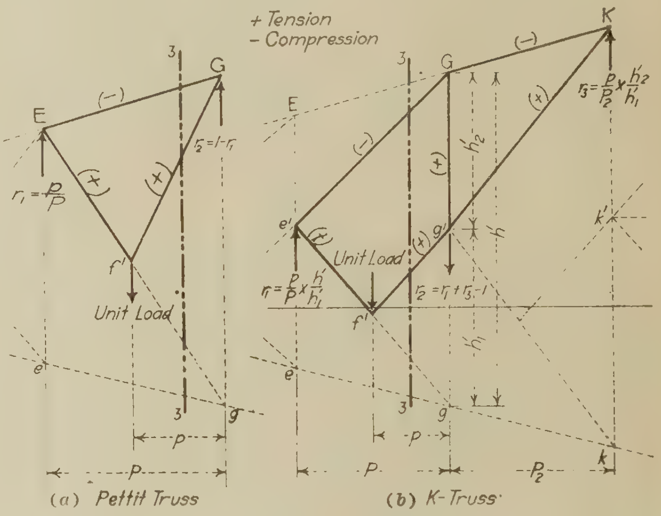
For such a simple case an influence line is unnecessary, the maximum stress being developed concurrently with the maximum floorbeam concentration at f′. An interesting point to observe, however, is that the vertical ordinate included between the lines ef_1g and ef_2g, Fig. 2 (d), at any point is equal to stress f′g′, due to a unit load at that point, multiplied by z_2/z_1, in which z_2 is the lever arm (not shown) of stress f′g′ about O_2. This may be proved from the construction of the figure, or by taking moments about O_2 of the stresses and external forces to either side of section 3-3, Fig. 1, with the unit load at f′. A similar relation exists with the Pettit truss, in which case the corresponding influence lines are eg and ef_2g, Fig. 2 (d), the member f′g′ becomes f′G, Fig. 3 (a), and the values z_2 and z_1 represent, respectively, the lever arms about the intersection of the chords of members f′G and f′g, Fig. 3 (a).

Stresses in Vertical Posts—These stresses follow directly from those in the diagonals. Thus, by resolving stress e′G into components at G in the directions EGK and Gg′, it is seen that

$$Gg' = e'G \times \frac{h_2}{i} \qquad (12)$$

and that the stresses in the two members are of opposite character. Therefore, Fig. 2 (c) may be used as the influence line for stress Gg′ by multiplying the ordinates by h_2/i. In like manner the ordinates to the influence line for stress f′g, multiplied by h_1/i_1, represent the stress in the lower part g″g of post g′g; the stress in the upper part g′g″ is equal to that in the lower except when there is a floorbeam load at g″.

The construction of certain of the influence lines is simplified if the sub-diagonal and main diagonal in a given panel are parallel. Thus, if d′e′ and c′E are parallel, line cd in Fig. 2 (b) will be parallel to en, and cd in Fig. 2 (d) will be parallel to eg; while if f′g′ is parallel to e′G, line ef_1 in Fig. 2 (d) will be parallel to fn. No convenient relations seem to obtain, however, for the usual case of equal length of sub-panels ($p = P/2$, etc.).



(a) Pettit Truss (b) K-Truss

FIG. 3
Showing Action of Secondary Systems

COMPARISON OF "SECONDARY SYSTEMS"

A comparison between the so-called "secondary systems" of the Pettit and K-trusses can now be made. In the Pettit truss, Fig. 3 (a), the frame Ef′G acts as a secondary truss system in transmitting any load at f′ in proportionate parts to the main panel points E and G. In the K-truss, Fig. 3 (b), for a unit load at f′, the secondary truss system is e′f′g′KG (shown by full lines), since e′G and g′K—in the absence of a member e′g′ corresponding to EG of the Pettit truss—must develop the horizontal components of stresses e′f′ and f′g′ respectively.

Evidently, then, the load at f′ is not transmitted proportionately to e′ and g′; nor is it transmitted proportionately to e′ and K, since the secondary truss—owing to the presence of the quadrilateral frame e′f′g′G—would be unstable if supported simply at these two points. The truss would be stable, however, if supported at e′, g′ and K.

Moreover, the reactions r_1, r_2 and r_3 at these points are not statically indeterminate, as they would be if the quadrilateral frame were braced by the insertion of members e′g′ or f′G. In fact, the presence of this frame, free to deform without change in length of its sides, furnishes the third condition (the other two being $\Sigma V = 0$ and $\Sigma M = 0$) required to determine the reactions by statics. (A familiar application of this principle is seen in the omission of diagonal bracing in the panel over steel supporting towers at the main piers of a cantilever bridge.) Thus, the value of r_1 may be found by applying the laws of equilibrium to joints f′ and e′; with r_1 known, r_2 and r_3 are readily determined. The values of these reactions, and the character of the stress induced in each member of the secondary system, are indicated in Fig. 3 (b). (For the general proportions shown, r_2 is negative.) The load at f′ must therefore be assumed to be replaced by *three* component concentrations at e′, g′ and K, equal and opposite to the reactions r_1, r_2 and r_3; the function of the secondary system being completed, f′g′ is no longer needed and the primary K-system transmits these concentrations to the supports.

CRITERION FOR STABILITY SATISFIED

It is appropriate here to direct attention to the fact that the K-truss, in either its primary form or with sub-panels, satisfies the familiar criterion for stability expressed by the equation $m = 2j - 3$, in which m is the number of members and j is the number of joints; so that the presence of the quadrilaterals e′f′g′G, etc., in the truss with sub-panels does not necessarily imply instability. That is to say, a truss does not of necessity have to consist of an assemblage of triangles in order to be stable; and in this case such members as e′g′ or f′G, inserted to reduce the truss to an assemblage of triangles, would be redundant, thus making the stresses in general statically indeterminate, as shown in the preceding paragraph by independent consideration of the secondary truss.

This analysis of the secondary system may be used to advantage in computing stress f′g, in either the Pettit or K-truss, by algebraic methods, since the sub-diagonal is eliminated from the forces at section 3-3, Fig. 1, without stressing f′g, which is not in the secondary system. On the other hand, its use in the determination of chord stress EG by the elimination of d′e′ (see section 1-1, Fig. 1) complicates rather than simplifies the work, since the stress in EG induced by its action in the secondary system must be determined and included in the final equation for stress.

The secondary system k′mn′m′ in panel KN, Fig. 1, serves to transmit a load at m proportionately to k′ and n′, as in the Pettit truss, after which the secondary members may be considered removed and the stresses in the primary K-system determined by the methods which have been developed, noting, however, that k′m acts as a member of both the secondary and primary systems.

[TO BE CONCLUDED]

Frontier Humor in an Official Report

In the last annual report of the Board of Road Commissioners for Alaska it was noted that "Alaska abounds in mineral wealth, fish and road-commission critics."

Denver Advised to Purchase Its Present Waterworks

Investigations Show Cost of a New System to Be Double That of Present Fixed Valuation—Existing Supply Ample

THE cost of a proposed municipal waterworks system for Denver has been estimated at $27,479,500, a figure more than double that of $13,415,899 given in a special master's report as the valuation of the existing Denver Union Water Company's works. The wide variation is due to the necessity of obtaining a supply from the Blue River, on the western side of the Continental Divide, as the remaining local sources of supply were found to be insufficient. In a report recently submitted to the Public Utilities Commission of Denver by H. A. Kluegel, chief engineer and G. H. Wilhelm, consulting engineer for Shirley Houghton, successor to the Van Sant-Houghton Company, engineers and contractors, of Denver and San Francisco, it is also claimed that the present supply is sufficient to meet Denver's needs for the next 20 years, and a purchase of the present waterworks system at the stipulated valuation is recommended.

THE SITUATION

The Public Utilities Commission, on July 27, 1915, employed the Van Sant-Houghton Company to complete the engineering work and to prepare plans, specifications and estimates for a complete and adequate system of waterworks to replace the existing system, owned by the Denver Union Water Company. A year previous to this, the city council had passed an ordinance regulating and fixing the charges by the Denver Union Water Company for water furnished the city and its inhabitants. The water company brought suit and received a favorable verdict in the United States District Court. As a result, the investigations of a new system were instigated and later the Van Sant-Houghton Company was employed.

An option agreement was executed Feb. 21, 1916, between the water company and the city granting to the latter an option to purchase the company's property at a valuation, as fixed by the special master's report, of $13,415,899, or as modified by certain additions and accrued depreciation. This agreement, in turn, bound the city to take an appeal of the rate case to the Supreme Court and to enter into no further contracts leading toward the duplication of the system. The city then instructed the Van Sant-Houghton Company to investigate also the condition of the existing waterworks system. Later, a supplemental contract was made calling for the discontinuance of all investigative work and the preparation of a preliminary report, the source of the following notes.

INVESTIGATING FOR A NEW SOURCE OF SUPPLY

When the Van Sant-Houghton Company was employed, the Public Utilities Commission suggested that the water supply be developed from within the South Platte drainage area, which is adjacent to Denver, and presented for consideration the following: (1) The ownership and operation of certain existing ditches; (2) the acquisition and operation of the Antero reservoir and the high line canal; (3) the selection of a reservoir site at the junction of the north and south forks of the South Platte; (4) the supply required for Denver with a population of 500,000 at a rate of 150 gal. per capita per day would be 84,041 acre-feet per annum; (5) the addition of a supply from the western slope, probably from the Blue River, in case the above supply proved insufficient. These suggestions were considered, together with such additional investigations and studies as were found necessary.

In determining the supply available from the eastern slope, a study was made of the existing water rights on the basis of the maximum allowable consumption, and a systematic development of the affected territory was considered in order that the maximum supply of water might be obtained. It was found that the Denver reservoir, located at the forks of the South Platte, would provide a storage capacity of 56,414 acre-feet, but that only 13,000 acre-feet of water could safely be estimated from the South Platte district, with an additional amount not exceeding 10,000 acre-feet from the Tarryall area if stored at the McKay reservoir site.

INVESTIGATION OF WESTERN SLOPE

This led to the investigation of the western slope possibilities, with a preference toward the Blue River project, which indicated a probable supply of 88,270 acre-feet. It would be necessary to carry the water from the Blue River through a tunnel to a stream leading to the Tarryall Creek and McKay storage sites and thence to the Denver reservoir. This would give a total supply of 111,270 acre-feet, which, less possible evaporation, might be reduced to 100,000 acre-feet.

From the Denver reservoir, with its dam 210 ft. high, a conduit of some 20 miles in length would carry the water to the purification works, which would have a capacity of 80 to 100 million gallons, sufficient to care for the city's existing needs. Rapid sand filters were proposed, together with preliminary subsidence and coagulation, and final disinfection. To care for peak demands, a storage reservoir was included in the distribution system. Because of existing hills a west-side pumping station and standpipe became necessary. The estimate of cost for this system, as given above, was found to be $27,479,500.

THE PRESENT SYSTEM

A study of the Denver Union Water Company's works, the report states, revealed resources amply sufficient to supply the maximum demand of 84,041 acre-feet per annum. Based on the recorded flow in the river during the last 40 years and on recorded amounts of storage, it is estimated that with an unheard-of failure of all sources of supply the probable minimum storage alone would supply the needs of the city for over four months. The per capita quantity of 150 gal. per day is commented upon as being neither economical nor necessary and subject to a reduction. With this in view it is claimed that the present supply will meet all demands for the next 20 years without the necessity of developing further resources.

The basis of the financial schedule is that the city acquire the property of the Denver Water Company by the issuance of bonds in the amount of $14,000,000 payable in 40 years and bearing 4½ per cent interest. A study of the operations of the company, modified to municipal-ownership conditions, gives a gross revenue of $1,300,000 and an operating expense of $280,000 for the first year. The bond sinking fund would commence in the third year and continue on a graduated scale so as to retire the bonds in the fortieth year. A 10-per cent reduction in present rates is expected by the eighth year. The surplus allows a high state of efficiency to be maintained.

In conclusion, H. A. Kluegel, chief engineer, recommends that the property of the Denver Union Water Company be acquired under the terms of the above-mentioned option agreement, adding: "The adequacy of the developed water resources can be asserted with greater assurance than that of any projected system, the plant is in active operation, the financial result can be forecast with certainty, while the difference in cost is so great as to fully justify it from an economic point of view."

Sink Concrete Cofferdam in Sand for Activated-Sludge Plant

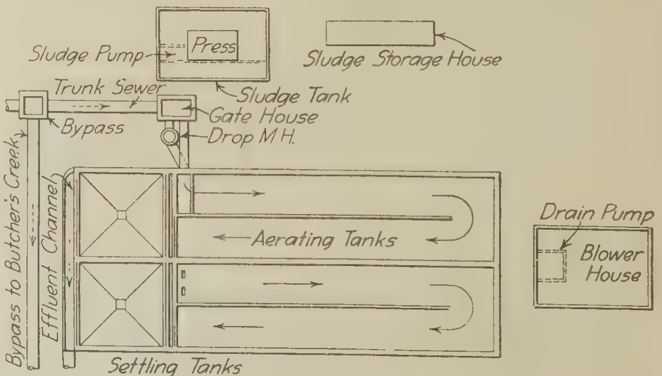
Small Town Works to Treat 1,000,000 Gallons of Sewage—Hydraulic Excavation with Centrifugal Pumps

INSIDE a concrete cofferdam sunk 22 ft. into a water-bearing sand, settling tanks for a new 1,000,000-gal. activated-sludge plant are being built at Escanaba, Mich. Hydraulic excavation and the simple design of the whole works are the features of the plant.

The works are located at the south end of the city, at the outlet of a new 3½-mile trunk sewer and about 2 miles from the outlet of the old trunk sewer. The new trunk serves a district which is not as yet very thoroughly settled except at the extreme north end, and will provide a flow for the next few years not to exceed 300,000 gal. per day. The old sewer, which has practically all the connections it will ever have, serves about 10,000 persons using 100 gal. of water per day. Plans and estimates have been made for a pumping station and force main to connect the old system with the disposal plant, the work to be done this season.

DAILY CAPACITY 1,000,000 GALLONS

The general layout consists of two long rectangular aërating tanks with a longitudinal vertical baffle, so that the inlet and outlet are at the same end, the end adjoining the two settling tanks. The total capacity of the aërating tanks is 220,000 gal.; and as one-half



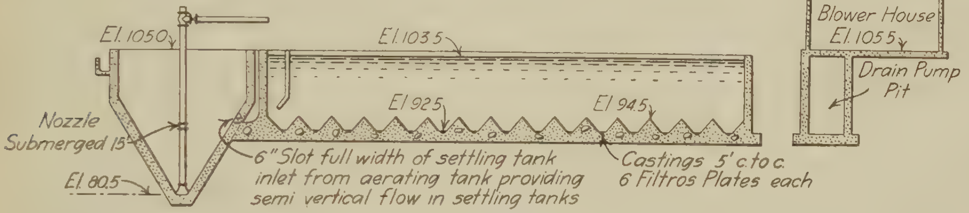
AËRATING TANKS ARE SIMPLE LONGITUDINAL BASINS WITH SINGLE BAFFLE of the total flow occurs in nine hours, a four-hour aëration period will give a daily capacity of nearly 1,000,000 gal.

The total capacity of the two settling tanks is 86,000 gal., which will give, with the corresponding four-hour aëration period, 93 minutes for the sedimentation period. By decreasing the aëration period to three hours the sedimentation period will be 70 minutes and the capacity of the plant will be 1,300,000 gal. per day.

Filtros plates having an area of 360 sq. ft. are used in the ridge and valley aëration tank, which has an area of 30,000 sq. ft. Thus the diffusion ratio is 1 to 8.3.

Air is to be distributed to the base of the plates from a Taylor spiral-riveted, galvanized-steel header, diminishing in size from 8 in. to 6 in. and then to 4 in. The drops from the header are 4-in. Byers galvanized wrought-iron pipe. All the valves have iron bodies and are bronze mounted with rising stems. The blower house is located at the opposite end of the aërating tanks from the settling tanks, and inserted in the main is a Venturi meter with U-tube monometer. Two Connersville blowers will furnish the air. The rated capacities are 1200 and 2400 cu. ft. per minute, and the motors driving them are 40 and 75-hp. General Electric 2200-volt motors.

Four 6-in. drain pipes, laid lengthwise of the aërating tanks, have 4-in. openings at each casting. They are connected with a 6-in. Fairbanks-Morse centrifugal pump located in a pump pit under the blower-house floor.


El. 105.0
El. 103.5
Nozzle Submerged 15'
El. 80.5
El 92.5
El 94.5
6" Slot full width of settling tank inlet from aerating tank providing semi vertical flow in settling tanks
Castings 5' c. to c. 6 Filtros Plates each
Blower House
El. 105.5
Drain Pump Pit

LONGITUDINAL SECTION SHOWS CONNECTION BETWEEN SETTLING AND AËRATION TANKS

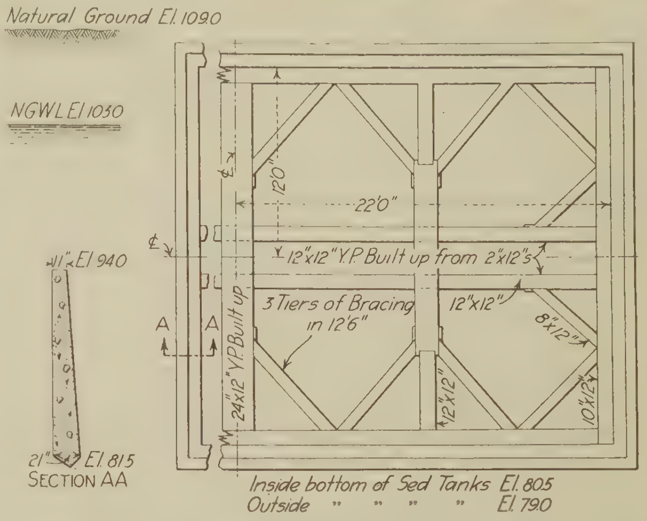
Sludge will be removed from the settling tanks by Harris nozzles through 8-in. cast-iron pipes back into aërating tanks, or to the sludge tank in the press house, where it may be further aërated from a 1-in. wrought pipe grid with perforations in the pipes 1 in. apart. From the sludge tank the sludge will be pumped by a 3-in. motor-driven centrifugal pump into a 6 x 9-in. Worthington filter press. The cakes will be wheeled to a small shed adjacent and stored on racks until disposed of. The supernatant water in the sludge tank will be drawn off by a perforated steel pipe on a flexible elbow, discharging into the drain sump at the blower house.

EXCAVATE COFFER HYDRAULICALLY

High ground-water level was at El. 103, making a head of about 24 ft. for the contractor to work against in getting in the points of the settling tanks. Excavation down to water, 6 ft., was carried out by team and scraper.

A concrete cofferdam, 24 x 44 ft. in inside dimensions and 5 ft. deep, was then built around the site of the settling tanks. The manner of bracing is shown in the drawing.

A 4-in. Morris centrifugal pump, driven by an 8-hp. Novo gas engine, was placed on the cross-bracing. A sump midway between the points of the settling tanks was dug by hand and the pump started. The discharge side had a tee next to the pump, one outlet of which led to the spoil bank and the other to a 1½-in. nozzle on a fire hose. When the water in the sump had been pulled down deep enough, the nozzle was turned on and the sand washed from under the wall into the sump. In this way the first 5-ft. section was lowered its full length. Then a 7½-ft. section was added to it, and after a week's curing pumping was resumed, using this time a 25-hp. motor instead of the gas engine. The cofferdam was sunk as before until the bottom edge reached El. 81.5, when it was a simple matter to place forms and concrete in the dry. The material was uniformly a medium coarse sand. Water from the excavation for the aërating tanks was led to the cofferdam pump, so that one pump took care of practically all the water.



COFFERDAM WAS CROSS-BRACED THOROUGHLY WITH BUILT-UP TIMBERS

In sinking the cofferdam from El. 103.8 to 81.5, cracks opened at about the center of each wall and in two opposite corners. When sinking was discontinued, cracks on three walls were open not more than ¼ in., and on the fourth wall next to the excavation for the aëration tanks the crack opened 1½ in. at the top and was closed at the bottom.

The total cost of the plant, including the press, blowers, motors, and pumps, is $38,750. The designs were made by W. J. Hodson, city engineer. M. B. Jensen, his assistant, is in charge of construction. Samuel Mills is the contractor.

Chilean Contractors Listed

A list of the contractors registered in the Department of Public Works of the Chilean Government has been compiled by Verne L. Havens, commercial attaché at Santiago. The list will be loaned on request to the Bureau of Foreign and Domestic Commerce, Washington, D. C. Inquirers should refer to File 2179.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Design of Proposed Multiple-Arch Dam in New Mexico Discussed

SIR: On page 604 of your issue of Nov. 11, 1916, there occurs a photograph showing a proposed multiple-arch dam of a very interesting type. Below this picture your reporter has added certain notes which add distinctly to the interest. The multiple-arch dam is a comparatively new development. The existing structures have been designed and built by specialists in this particular line, as have most of the buttress dams of other types. No multiple-arch dam failures have occurred.

Until the general principles underlying the successful use of this and other forms of structural dams are very generally understood it is important that no misstatements nor improper designs of this class of structure should be permitted to pass unnoticed. I therefore wish to call attention to certain important respects in which the design as published needs correction before it can result in a stable and safe dam.

The construction of a dam on a mattress assumes flexibility, or at least a structure of a form that will be stable after settlement has occurred. In a multiple-arch dam the thrust of the face arches is balanced as long as they remain in their intended place. If during settlement the moving buttress moves out of alignment in either a horizontal or a vertical plane the thrusts are no longer in line and balanced across the entire face of the structure. If the buttress has also settled sidewise and is tending to overturn sidewise this condition is aggravated. As settlement must involve both of these tendencies it is evident that extreme care must be used in placing such a dam on a soft, yielding base.

The more nearly an arch approaches the semi-circular the less the side thrust on its buttresses is balanced by its mates. The less the subtended arc, the greater the thrust. Multiple-arch dams depend for arch stability on the balancing of these thrusts, and to secure a high degree of safety they must be made small by using arches as nearly semicircular as can be had.

There is another reason for the use of short radii, and that is that the load, and so the thickness of the arch, varies inversely with the radius. As too short a radius would result in too close a buttress spacing for the minimum of materials, considerable care needs to be taken in selecting these important constants.

But the buttress stands as an unsupported wall or column free on three sides for much of its length, so that the unsupported length of its rear edge, its weakest section, may determine the stability of the entire dam. The spacing and size of the struts will be determined by the requirements at this edge. And not only static but vibratory stresses tend to concentrate here.

In well-loaded materials, such as the concrete and steel of such a dam, minor shocks and repeated rhythmic stresses of a vibratory nature must be carefully avoided as tending to open up structural defects. Therefore there should be avoided any tendency to produce water shocks. The spillway should be a smooth rollway with the shock and energy absorbing devices in the stream bed well below the main structure. If at all possible the spillway should be entirely independent of the dam. If it must be on the dam it should discharge the water in a smooth, shallow stream.

On torrential streams the spillway must be a free opening. Neither hand nor automatic gates should block the free flow of the floods. This is particularly important where any impeded flow is apt to pass over portions of the wall from which it can drop on soft unprotected foundations.

The use of a concrete girder or slab, loaded edgewise, 400 ft. long and 200 ft. deep, to carry a load of 150,000 tons applied at an angle to the flat face of the slab is unusual, but may be possible. But the use for this purpose of a relatively thin slab attached to friable and yielding supports or end seats and resting on loaded piers spaced along its length appears to be undesirable. As these loaded piers settle the slab will receive unexpected side loads and be fractured and bent out of line with its own load.

It would be so thick that but few weep holes could be provided through it, and yet so light as compared with the possible uplift pressure that it might be ruptured by reversal of pressure from seepage from the cut-off wall.

The illustration presents other undesirable features, but none so likely to render the entire enterprise futile as those outlined above.

RALPH BENNETT,
Consulting Engineer.
Los Angeles, Cal.

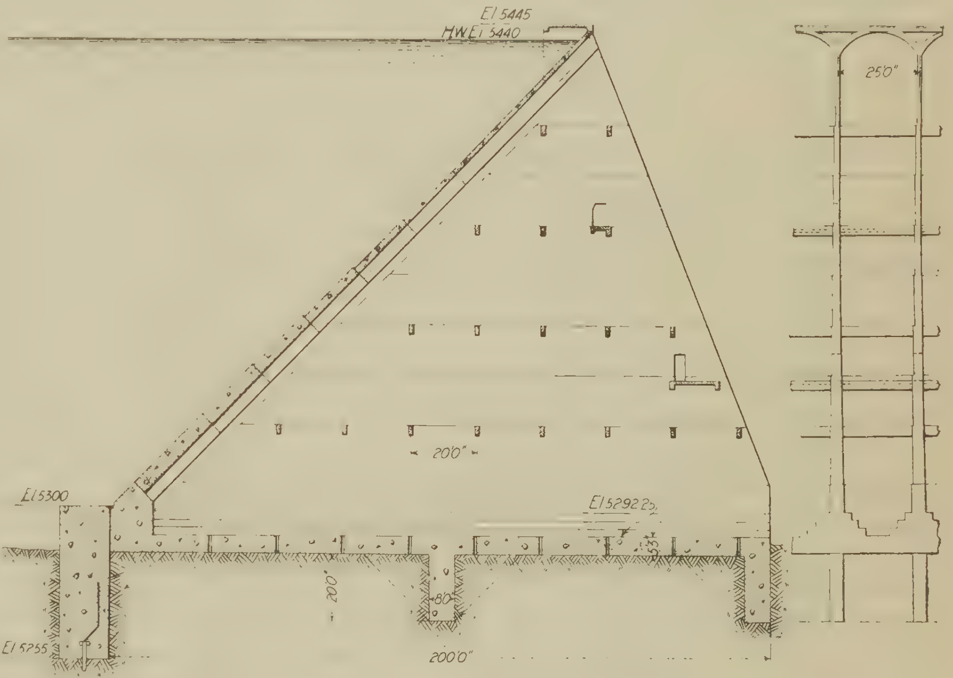
[Mr. Bennett's letter was submitted to A. G. Hillberg, designer of the dam in question, and his reply follows.]

SIR: Mr. Bennett has raised some questions as to the safety of the design prepared by me for the dam of the Rio Grande Light, Heat & Power Company. It is unfortunate that the picture prepared from the drawings does not give complete details of the design, but how could it do so? Actual photographs of engineering structures generally show very little of the details, and how, then, could a picture, made by an artist without engineering training, be made to show more? Consequently, I think that Mr. Bennett's reference to "certain important respects in which the *design as published* needs correction before it can result in a stable and safe dam" is not justified, as the details of the design have not been explained.

The first question raised refers to the foundation mattress, and doubts have been expressed as to whether this part can be made stiff enough to act as a girder. As shown in the accompanying drawing, this mattress has a minimum thickness of 5 ft. 3 in. and its width in the up-and-down stream direction is 200 ft. On the upper side the spread footings of the buttresses act as vertical stiffeners, while in the transverse direction three ribs, of which one is located on the upper side and two on the under side, stiffen the girder and serve to check deflections. The upper stiffener also serves as a seal between the mattress and the arches, and it is braced against the buttress footings. The ribs on the under side are braced underneath each buttress; in other words, at 25-ft. intervals. Reinforcement will supply additional strength to these ribs, as well as to the mattress.

In respect to the arches, Mr. Bennett does not seem to realize that they appear in a projection of 45 deg., and in addition there is the possibility that the artist has drawn them shallower than they actually have been designed. Everybody knows that the most economical subtended angle of an arch of circular shape loaded with a radially acting load is about 133 deg. and that the volume of the arch does not vary appreciably for variations in this angle between the limits of 120 deg. and 150 deg. In the case in question the radius of the intrados is constant and 12.5 ft. in length. This length is one-half the spacing on centers of the buttresses, so that really the subtended angle is 180 deg. However, the thickness of the buttresses cut in on this angle, so that it actually is somewhat smaller.

To offset this effect the radius of the extrados has also been kept constant, so that the thinning of the crown carries with it, comparatively speaking, a thickening of the haunch. This procedure also has the advantage of enabling the standardization of the form-work, so that steel forms can be used.



GENERAL FEATURES OF PROPOSED MULTIPLE-ARCH DAM ON RIO GRANDE

Another question has been raised as to the stability of the buttresses. It might be sufficient to indicate that these buttresses have been designed as cantilevers, held by the horizontal struts, so that should a row of arches collapse accidentally, the adjacent buttresses will be able to sustain the unbalanced arch thrusts from the adjoining panels.

In respect to the stepped spillway Mr. Bennett has advanced the theory that the discharge over it will tend to create rhythmic vibrations. The writer has been in the position to observe a number of such spillways abroad, the type of construction being more common there than here, and has found that the flow changes constantly, so that rhythmic vibrations hardly can occur. Engineers have often heard the expression "trembling dams," meaning dams that vibrate when discharging. However, this is not due to the direct pounding of the water but to a vacuum underneath created by a falling sheet and the pulsation of the water level inside the nappe.

It must be admitted that the spillway question for this dam has been difficult to solve, and that the existing design might be modified before construction is commenced. First, a separate spillway, blasted out of the rock in the right bank, was investigated, but found too costly. The ogee shape was abandoned because of the softness of the foundation below the dam and the difficulty of building effective energy and shock absorbers. Under the proposed plan a riprap paving about 100 ft. in length will be placed below the spillway.

In respect to the torrential nature of the stream, I do not call a stream torrential when the maximum discharge observed during 25 years is 24,800 sec.-ft. and the drainage area about 150,000 square miles. Of course for safety the spillway capacity has been made far in excess of this requirement. As to the advisability of installing automatic crest gates, their cost is high and few of them are satisfactory when installed at an inaccessible place, where it is difficult to make repairs.

A spillway without gates would be rather long and the available space is not sufficient. To provide a short and deep spillway without gates would mean a loss of storage, as the overflow would be about 14 ft. deep. As the reservoir, when full, has a length of about 15 miles and a surface area of approximately 1000 acres, it is obvious that there will be time enough to hoist a sufficient number of gates to accommodate an increase in the discharge.

The next question refers again to the safety of the mattress to carry the load of 150,000 tons. First, this load is nearer 200,000 tons than 150,000 tons, as a considerable reaction from the cutoff wall has to be taken care of. As the vertical loading of the foundations is about the same, the coefficient of friction, should the dam tend to slide, would be about one. This, of course, is not safe, assuming that the girder action of the mattress were insufficient to hold the dam in place.

To increase the load on the plane of sliding and at the same time place this plane at another elevation than the under side of the mattress the two stiffening ribs on the under side have been made deep enough to develop a friction coefficient of about 40 per cent. The material inclosed between these ribs will act as a direct load on the plane of sliding thus determined, and in addition the difference between the active earth pressures on their upstream sides and the passive pressures on their downstream sides will also contribute to the resistance to sliding.

Uplift pressures on the base have been safeguarded against, first, by a deep cutoff, and, second, by weep holes through the mattress as shown.

It has been the intention to describe fully the features of the design of this dam, but that it has not been done before is explained by the fact that some modifications may be incorporated before the structure is built. Therefore at a later date a full description will be furnished, and it is hoped that it will clear up definitely any explanations that might appear unsatisfactory in this brief statement.

A. G. Hillberg,
Hydraulic Engineer.

New York City.

Water the Chief Factor in the Making of Good Concrete

Sir: Nathan C. Johnson is always interesting in his forcible way of expressing his ideas on the subject of the mixing of concrete. His article in your issue of Dec. 30, 1916, page 790, should attract a great deal of attention, and undoubtedly it will. The writer was present recently at a meeting where representatives of various materials were trying to assist a city council to avoid making a mistake. The article by Mr. Johnson was used very effectively by a publicity man for a material not friendly to concrete. The writer had not seen the article, for he was busy when the Engineering Record was laid on his desk that afternoon. He read it eagerly, however, the following morning.

Mr. Johnson is following a lot of us who have been on record many years as opposed to too much water. He has, however, the advantage over many in that he has studied the subject with the aid of still-life and moving-picture cameras and the microscope. He can give pictures, and the modern man to-day does not like to read an article not well illustrated. He stops short, however, of telling us how much water to use, and says too little about the consistency of concrete.

Ten years ago the writer began writing into his specifications the following clause: "The contractor shall use only that amount of water which will make the concrete pasty and sticky and not free-flowing. It shall be of such a consistency that it will flow freely from a wheelbarrow, but the discharge must be assisted by hoe or shovel." He now recommends that the consistency shall be that of a medium-soft or soft tooth-paste, for it is not difficult to obtain a sample in the nearest drugstore.

It is not enough to tell men not to use too much water, but they should be told just how much water to use. Consistency is what we are to work for. When the writer started in business all concrete was mixed until it had the appearance of being damp rather than wet. A handful squeezed retained the imprint of the fingers when the hand was opened and the lump could be shaken down readily. The specifications required that the material be tamped until it quaked and free water rose to the surface. That was an ideal consistency. The trouble was that the tamping was seldom carried to the proper point. The building blocks made in many plants, where the tamping is merely a light compacting, are a good example of how much of the old concrete was made. With the proper tamping it was good.

A number of laboratory experiments have been made in the last five years, and they all show that too much water is bad. A big drawback to the value of the published results is that the men who publish the results express the amount of water in percentage. Percentage of what? There is nothing in the printed pages to tell whether it is a per cent of the cement, of the sand-cement paste or of the whole mixture. One writer says we should use 10 per cent of water and another says 25 per cent. It is barely possible that each writer is describing the same consistency, but there is nothing to tell us that.

The writer was chairman last year of the committee on mixing and placing of concrete of the Second National Conference on Concrete Road Building, reporting to the convention in February, 1916. To obtain material for the report the committee made experiments in concrete mixing in the field. The T. L. Smith Company, of Milwaukee, laid a new concrete driveway in the plant, and the committee was allowed to take complete charge of the mixing and placing of the concrete. The complete report was printed in the report of the Second National Conference on Concrete Road Building, copies of which may be obtained from the Portland Cement Association in Chicago. Copies of the committee report alone may be obtained from the T. L. Smith Company, Milwaukee.

In these field tests it was found that the amount of water should not exceed 6 lb. per cubic foot of loose materials, which includes cement, sand and aggregate. If the sand and aggregate contain much moisture, the amount of water to add may be as low as 4 lb. per cubic foot of loose materials. The amounts stated will of course be varied according to the amount of moisture in the materials, bearing in mind that consistency is the big thing. This in general terms may be stated to be that of a soft or medium-soft tooth-paste, with the further limitation that no free water shall cover the surface when the mixture stands 5 minutes, and that it cannot run like water or cream from the wheelbarrow, cart or bucket in which it is conveyed from the mixer.

Next to the correct amount of water is the time of mixing. The water should begin running into the mixing drum just before the materials are dumped in. The mixing should continue for not less than 1 full minute after all the materials are in the drum. This is to insure the incorporation of the water, for it takes time to get it into all the voids. A long mix makes stronger concrete, for the reason that all the water is where it should be.

On this point, however, there needs to be a cautionary note sounded. One experimenter, a professor, published a statement that mixing 2 or 3 minutes was no better than mixing 1 minute or even ½ minute. The writer took the matter up with him and found that he had not varied the amount of water with the time. This is where he made his mistake. For short-time mixing more water is required. If a certain amount of water gives good results with a 1-minute mix, the amount should be reduced slightly for a 2-minute mix and still more for a 3-minute mix. With these reduced amounts of water and increased time of mixing the same consistency is obtained, and it is consistency we are trying for. Consistency has been very truly defined as being a jewel, and the concrete engineer should appreciate this fact. In our Milwaukee tests, which were rough field tests and not marked by laboratory refinements, it was found that there was a remarkable decrease in strength with additional water.

The writer does not like Clause 1 and Clause 2 of the specifications proposed by Mr. Johnson. These clauses deliver the contractor over into the hands of the engineer in a disagreeable manner. Such general clauses the contractors are just now seeing some hope of getting away from, and the Engineering Record has exerted a telling influence in this direction.

Clause 1 should read as follows: "The concrete used shall be of the proportions hereinafter set forth, and the contractor shall be permitted to vary the proportions to allow of the most economical use of materials, provided that the concrete shall show a strength to compression at the end of thirty days, when tested in an 8 x 16-in. cylinder, of not less than —— pounds per square inch."

Clause 2 should read as follows: "No batch of concrete shall be considered as properly mixed until it has been in the revolving mixer drum for not less than 1 full minute after all the materials have been put in the drum. The mixer drum shall revolve with a circumferential travel of not less than 120 ft. nor more than 160 ft. per minute. The concrete when discharged shall be of a consistency which shall not be free-flowing, but shall be pasty and sticky and approximating to a soft tooth-paste. If the concrete stands 5 minutes in the forms or in any receptacle, there shall not be present a film or covering of water. The maximum amount of water permissible shall be 6 lb. per cubic foot of cement, sand and aggregate, and this amount shall be reduced if the materials carry so much moisture that 6 lb. of water makes a sloppy or over-wet concrete. If this amount of water does not produce a soft enough concrete with a mix of 1 minute, then the mixing shall be continued until the proper consistency is obtained, but the amount of water shall not be increased.

If the two clauses read as above written, then Clause 4 and Clause 5 presented by Mr. Johnson can be omitted, his Clause 3 being all right.

ERNEST MCCULLOUGH,
Consulting Engineer.
Chicago.

[Copy of Mr. McCullough's letter was submitted to Mr. Johnson, whose reply follows.]

SIR: I have your favor of Jan. 17 inclosing a communication from Mr. McCullough.

The opening paragraph strikes the keynote of his reply. My article on the influence of water in concrete has been "used effectively by a publicity man for a material not friendly to concrete." It would seem as if the concrete interests should have been primed with equally conclusive evidence concerning this "unfriendly product" before coming to conference. Mr. McCullough is quite aware that unfriendly deductions are unwarranted and may not be read into any of my writings, so far as concerns concrete when properly made. But the case of concrete is obtrusively before the bar of engineering opinion; and judgment will be pronounced according as inexorable natural laws which govern its making have been obeyed or violated. The writer takes this opportunity to voice his unqualified approval of the right kind of concrete for the right purpose and of his unqualified disbelief in all sorts of concrete for any and every purpose. Such of his studies as have been made public thus far have been given out in the hope of making successful uses of concrete more general than they have been in the past.

The second paragraph of Mr. McCullough's letter is misleading. The Portland Cement Association, with which Mr. McCullough is associated, has had unparalleled opportunities and facilities for years past to obtain information with regard to their product. Better facilities as regards still-life and moving-picture cameras and microscopes have been available to them than to myself, with the added and inestimable advantage of ample funds to prosecute research without, as the writer has occasionally done, straining of finances and personal strength to the limit in order to obtain results. And it is not discovery to say that the writer stops short of telling how much water to use, inasmuch as that fact is emphatically expressed in the body of the article on which Mr. McCullough comments; and in an address on Dec. 14, 1916, before the Portland Cement Association in New York City, that fact was again emphasized and an urgent plea made that the Portland cement manufacturers tax themselves one mill per barrel per annum for research, in order that quantity of water and other moot questions might be solved, so that the product, by the making of which they gain their livelihood and on the continued use of which the security of their invested millions depends, should not be sold, as at present, with no instructions as to its use.

It is difficult to comment concisely upon Mr. McCullough's letter. Mr. McCullough is too thoroughly an engineer and too conversant with concrete to really advocate some of the things given therein. Comparing concrete to tooth-paste is somewhat indefinite and rather difficult. At what temperature shall tooth-paste be when its consistency is sampled? When concrete embodying large aggregate is used, in what manner shall this consistency be approached? If exceedingly fine sand, such as is found in many parts of Texas, is used in the concrete, and relatively fine aggregate, shall 6 lb. of water, regardless of proportions, be adhered to, or may the temptation to add a pail or two per batch be indulged, to produce tooth-paste consistency? And in what manner and by what police power shall 6 lb. of water and prolonged mixing to produce tooth-paste consistency be forced upon a contractor, particularly one who may have been losing money for one reason or another? Is the Portland Cement Association willing to sell its cement only to those who will guarantee to mix for 1½ or 2 minutes, or would it be overjoyed to sell 5000 bbl. of cement, whether it was to be used by Mr. McCullough or by an African savage?

These matters are too real and of too great importance to be trifled with, or dismissed with apologies either for myself or my writings, or for concrete and its limitations. A condition confronts the concrete industry which it has begun to heed, but the importance of which is not fully realized. In the move for industrial preparedness, are we to overlook the vital problems presented by this great concrete industry? Mr. McCullough's letter is interesting as a viewpoint, but it misses the mark. Research and more research until this problem is solved is the insistent demand. A little light is showing ahead, but not the bright light that will give us the clear vision which is so vital a necessity.

Nathan C. Johnson,
Consulting Concrete Engineer.

New York City.

Literature

For the Civil Engineer and Contractor

New Publications

Modern Underpinning—Development, Methods and Typical Examples. By Lazarus White, C.E., and Edmund A. Prentis, Jr., E.M. Cloth, 6 x 9 in.; 94 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., $1.50 net.

Hydroelectric Power. Volume 1—Hydraulic Development and Equipment; Volume 2—Electric Equipment and Transmission. By Lamar Lyndon. Cloth, 6 x 9 in.; 499 pages and 360 pages respectively; illustrated. New York, McGraw-Hill Book Company, Inc. Volume 1, $5 net; Volume 2, $3.50 net.

Proceedings of the Twelfth Annual Convention, American Concrete Institute, 1916. Edited by the secretary and John M. Goodell. Cloth, 6 x 9 in.; 569 pages; illustrated. New York, H. D. Hynds, secretary, 30 Broad Street.

Sewage Disposal for Village and Rural Homes. By C. S. Nichols. Bulletin 41, Engineering Experiment Station, Iowa State College. Paper, 6 x 9 in.; 31 pages; illustrated. Ames, Iowa, Engineering Experiment Station, Iowa State College.

Report—State Water Problems Conference, California. Paper, 6 x 9 in.; 125 pages. Sacramento, Cal., State Printing Office.

Findings and recommendations of the conference appointed under act of the California legislature to recommend "a unified state policy with reference to the irrigation, reclamation, water storage, flood control, municipalities and drainage, with due regard to the needs of water power, mining and navigation."

Steel Railway Bridges—Designs and Weights. By Edward C. Dilworth, designing and contracting engineer, Pittsburgh-Des Moines Steel Company. Cloth, 9½ x 12½ in.; 185 pages; illustrated, including 105 full-page plates. New York, D. Van Nostrand Company. $4 net.

Elements of Hydraulics. By S. E. Slocum, B.E., Ph.D., professor of applied mathematics in the University of Cincinnati. Second edition, revised and enlarged. Cloth, 6 x 9 in.; 329 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $2.50 net.

Handbook on Wood Preservation. Cloth, 6 x 9 in.; 73 pages; illustrated. Baltimore, Md., American Wood Preservers' Association.

Awakening of Business. By Edward N. Hurley, chairman of the Federal Trade Commission. Cloth, 5 x 8 in.; 240 pages. Garden City, N. Y., Doubleday, Page & Co. $2 net.

The Engineer in Public Service—Part 1. By Frederick E. Breithut. Bulletin 78, Bureau of Municipal Research. Paper, 6 x 9 in.; 71 pages; illustrated. New York, Bureau of Municipal Research. 75 cents.

The Ohio-Michigan Boundary—Volume I of Final Report, Ohio Co-operative Topographic Survey. By C. E. Sherman, C.E., inspector. Cloth, 6 x 9 in.; 115 pages; illustrated. Columbus, Ohio, Co-operative Topographic Survey.

This is the first of four volumes of the final report on the relocation of the Ohio-Michigan boundary line. Volume 2, entitled "Description of Surveying Marks and Monuments Used in Making the Topographic Survey of Ohio," will soon be issued.

Bridge Manual—State of Oregon. Containing Standards, General Information and Instructions. Prepared under the direction of John H. Lewis, state engineer. Paper, 4½ x 7¼ in.; 154 pages; illustrated. Salem, Ore., Office of State Highway Commission.

New Ideals in Business. By Ida M. Tarbell. Cloth, 5 x 7½ in.; 339 pages. New York, The Macmillan Company. $1.75 net.

Geography of the Upper Illinois Valley. By Carl O. Sauer. Bulletin 27, State Geological Survey. Cloth, 7 x 10 in.; 208 pages; illustrated. Urbana, Ill., State Geological Survey, University of Illinois.

Convict Labor for Road Work. Bulletin 414, Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 218 pages; illustrated. Washington, Government Printing Office.

Valuation, Depreciation and the Rate-Base. By C. E. Grunsky, Eng.D., and C. E. Grunsky, Jr., E.M. Cloth, 6 x 9 in.; 387 pages. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $4 net.

Report to the American Manufacturers Export Association by the Industrial Commission to France. W. W. Nichols, chairman. Cloth, 8 x 11 in.; 256 pages; illustrated. New York, American Manufacturers Export Association. (Commented on in the editorial pages of this issue.)

Books Reviewed

Elements of Hydraulics

Author, S. E. Slocum, B.E., Ph.D., professor of applied mathematics at the University of Cincinnati. Second edition, revised and enlarged. Cloth, 6 x 9 in.; 329 pages; 221 illustrations. New York, McGraw-Hill Book Company, Inc. $2.50 net.

Reviewed by A. G. Hillberg
Hydraulic Engineer, New York City

This book, of which the second edition has now appeared, seems to have found its place as a textbook for students, as indicated by the quick sale of the first edition, which was reviewed in the Engineering Record of March 13, 1915, page 338. The book had then 294 pages and 210 illustrations, and some matter of importance had not been treated as fully as might be desired.

In the second edition the author has revised his text and added much of value. In Part I, "Pressure of Water," is added a chapter on strength of pipes under internal pressure. Only the stresses due to internal pressure are considered, and the treatise is based on the assumption that the diameter of the pipe is negligible when compared with the pressure head; or, in other words, that the pressure of the fluid is the same at the top of the pipe as at the bottom. This, of course, is never true, but for small pipes under relatively high pressure the difference is so small that its influence is negligible. For larger pipes the weight of the water contained in the pipe also creates moments in the shell, but the analysis of this problem evidently is too complicated, in the opinion of the author, to be included in a book treating the elements of hydraulics.

In the second part, "Flow of Water," the author has revised considerably the chapter dealing with weirs. Paragraphs on submerged weirs, triangular notch weirs and the Cippoletti weir have been added and the treatment in general made more rational. To the chapter on loss of head in pipes the author has added paragraphs dealing with exponential formulas, a diagram giving the loss in head, the discharge in second-feet, the velocity and diameter for wood-stave pipes, and treats the flow in cast-iron pipes, deterioration with age, and flow in steel pipes and concrete pipes. The chapter on the influence of bends and elbows on the flow has also been rewritten and much new matter added; as for instance, experiments by Williams, Hubbel and Fenkell, Schoder, Brightmore, Davis and Balch.

The following chapter, on enlargement of section, has been added to, and the application of the Bernoulli theorem to problems of this kind has been clearly shown. In the discussion on the hydraulic radius the use of the Kutter, Bazin and Williams and Hazen formulas to problems pertaining to the flow of water in pipes is explained. In the chapter on modern siphons the author shows not only American siphons, but also types representing the practice abroad, where sometimes waterwheels have siphonic intakes.

The old chapter on backwater has been eliminated entirely and new matter substituted. The methods now given are those used generally by engineers, and the complicated mathematical treatise often adopted by writers of textbooks, but seldom, if ever, used in practice, has been omitted.

The chapter on turbines and their appurtenances was unusually good in the first edition, but the author has nevertheless revised it and added much new matter. The paragraphs on water hammer have been rewritten and a chapter on surge tanks added. As in the former edition, the last pages are in the form of an appendix containing tabulated hydraulic data. Two new tables have been added, one on the discharge from woodstave pipe and the other on submerged weir coefficients, so that there are now 22 tables covering 35 pages.

Hydroelectric Power

Author, Lamar Lyndon. Volume 1—Hydraulic Development and Equipment; Volume 2—Electric Equipment and Transmission. Cloth, 6 x 9 in.; 499 pages and 360 pages respectively; illustrated. New York, McGraw-Hill Book Company, Inc. Volume 1, $5 net; Volume 2, $3.50 net.

Reviewed by David R. Cooper

Designing Engineer, Power Construction Company,
Worcester, Mass.

Students and practising engineers interested in the design of hydroelectric-power plants will wish to add this book to their libraries. It constitutes a timely addition to engineering literature, coming when general interest in water power is being revived.

The work, as may be inferred from the title, is quite general in scope, covering both the hydraulic and electrical phases of design. Volume 1 is entitled "Hydraulic Development and Equipment," and Volume 2 is entitled "Electrical Equipment and Transmission." However, it should not be concluded that the two volumes are entirely independent of each other. As the author puts it in the preface to Volume 2, "this volume forms a companion to, and is, in fact, a continuation of Volume 1. There is no definite point of division between the two volumes, and this treatise was divided into two sections solely to make it less cumbersome and more convenient for reference." Volume 1 could certainly not be considered as complete in itself without a considerable part of Chapter 5 in Volume 2 on the design and testing of power stations.

On the whole, it may be said that the author's work is well done. In scope the book is excellent; it touches on almost all phases of plant design and defines the principles governing design very well. Naturally, some features into which the author has probably gone deepest in his own practice are treated more fully than other features that would be of equal or more interest to other engineers; however, the treatment of topics is very well balanced.

Mr. Lyndon follows one custom that might well be emulated by other authors. This consists of introducing mathematical discussions and formulas directly in connection with the solution of specific designing problems. Another noteworthy feature of the author's methods which is not so commendable is a very strong tendency to represent variable factors as having constant values. In numerous places he states fixed values for coefficients and definite limits of practice that are unfortunately not subject to such definiteness. Nevertheless the author's assumptions of positive values in many cases at least have the merit of constituting very good average values.

There are several noteworthy new features, including a discussion of the design of curved draft tubes and concrete scroll cases for vertical low-head turbines. A chapter is included on "Movable Crests for Dams." The author takes issue with some writers on upward pressures under dams, includes a so-called "exact formula" for computation of sections of a gravity dam and also condemns as uneconomical the general practice of using structural steel towers for transmission line supports instead of wooden or reinforced-concrete poles. He also advocates less exacting processes for the determination of stream flow.

A number of very good charts and diagrams are included. The illustrations are excellent, and the publishers have done their part well.

Water Supply

Author, William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute. Cloth; 6 x 9 in.; 528 pages; illustrated. Fourth edition, rewritten. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.75 net.

Reviewed by Weston E. Fuller

Consulting Engineer, Hazen, Whipple & Fuller, New York City

Professor Mason, in rewriting his well-known book, "Water Supply," for its fourth edition, has, while retaining the many excellent qualities of the earlier editions, added to and revised it so as to make the book a thoroughly modern treatise of water supply from the sanitary standpoint.

The grouping of the material into chapters is the same as in the earlier editions. Much data relating to recent progress in the art have been added and the book revised to meet the requirements of modern practice. The author has continued his excellent method of including a digest of the views of different authorities, with his own comments and explanations.

The book is exceptionally well arranged and illustrated. It is essentially one on water supply from the sanitary standpoint, and is not intended as a treatise on the other elements of water supply. Some data on the various types of purification works and the cost of the same are, however, included. The chapters on drinking water and disease, stored water, and the action of water upon metals are particularly useful.

When Will They Fall in Line?

The constitutions of Kansas, South Dakota, and Wyoming prohibit these states from participating in works of internal improvement, and consequently from issuing state-road bonds.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Canvas Envelope Makes Steel Cofferdam Tight Under 38-Foot Head

By H. W. STREULI

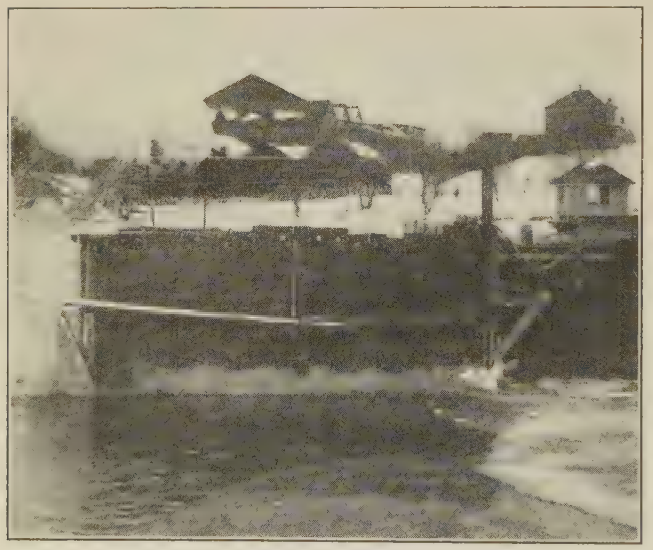
Schenectady, N. Y.

LEAKS in a single-line steel cofferdam, where the usual methods of applying fine material around the outside of the sheeting could not be used because of the proximity of a waterworks intake, were stopped by the writer with the use of a four-piece canvas envelope, the space between which and the sheeting was stuffed with cinders. The cofferdam was used in constructing a new intake and gatehouse for the Salem (Mass.) pumping station at Wenham Lake, North Beverly, Mass. The cofferdam was made of 50-ft. arch-web Lackawanna steel sheet piling, driven with a steam hammer during the month of March in 30 ft. of water. The following month the lake rose to high-water mark, giving a total head of 38 ft. on the bottom of the dam. All the sheeting had to be driven through 7 ft. of coarse gravel and 5 ft. into the underlying sand and clay without any dredging on account of the closeness of the cofferdam to the old intake and pipe line, which was still supplying the city of Salem with water. Under the hard driving, made necessary by these conditions, the steel was considerably bent and twisted in spite of the care taken to prevent this. Naturally, severe leaks resulted, which had to be closed before the dam could be unwatered. The old intake and pipe line being within 10 ft. of one part of the dam, it was naturally out of the question to use ordinary methods of blanketing or puddling, or to dump any such material as cinders, sawdust or manure into the water around the dam.

> **"Every Picture Tells a Story"**
>
> THERE NEVER WAS ANYTHING MORE TRUE. *Every picture* DOES *tell a story, and we'll wager you've got a stack of pictures from every job.*
>
> AND SOME OF THESE PICTURES *tell a* BIG *story—one that every contractor would like to hear—and that you'd enjoy telling.*
>
> WITH A FEW PARAGRAPHS—*the few you'd use if you were showing it to Bill or Ed—send it along. You'll receive a check for it when it appears in*
>
> "HINTS FOR THE CONTRACTOR."

A sufficient number of strips of heavy second-hand canvas, long enough to reach from a point 1 ft. above high water to the bed of the lake and leave 6 ft. to spare, were secured and sewed together to make four sides. To each of these sides a row of old brick was sewed with wires at the very bottom edge of the canvas. Another row of brick was sewed in the same way parallel to the first, but about 5 ft. above it. The top of the canvas was then fitted with short pieces of rope about 3 ft. apart. The two pieces for the sides of the dam were long enough to lap 6 ft. around each end of the dam, while the end pieces were made the exact length of the ends of the dam. The pieces were lowered separately so that when the bottom row of brick landed, it was parallel to and about 5 ft. away from the base of the steel. The top of the canvas was then draped in toward the steel so that the second row of brick would land near the sheeting, leaving the canvas hanging vertically a few inches away from the steel.

At each corner of the dam, two narrow 1-in. boards 38 ft. long were lowered vertically, one on the outside and the other on the inside with the double thickness of canvas between them, and nailed together by a diver, to hold the lap securely. The diver also inspected the bottom of the canvas and placed some additional ballast in the shape of sand bags.



TWO ROWS OF BRICK SEWED TO BOTTOM OF CANVAS MADE FLAP LIE FLAT ON LAKE BED

LEAKAGE HANDLED BY 4-INCH PISTON PUMP

When the envelope was in place, the entire space between it and the steel was filled with screened soft coal cinders, rammed lightly as they were put in. The dam, on being unwatered with a 10-in. centrifugal pump, proved tight, the only leakage being through the bottom and through the portion of the steel sheeting which was below the bed of the lake in the seam of gravel. This leakage was handled throughout by a 4-in. piston pump. It could not be avoided, as it was impossible under the conditions to blanket the surrounding bottom of the lake with impervious material, or to dredge a trench around the cofferdam and backfill it with a mixture of clay and gravel.

After the completion of work inside the cofferdam, canvas was removed and found in excellent condition. The work described was carried out by the Bay State Dredging Company, of Boston, for which the writer was superintendent.

One-Legged Skid Derricks

IN SINKING wood sheeted pits from 20 to 40 ft. deep for the foundations of the transmission-line towers of the Beach Bottom plant of the American Gas & Electric Company, described in the Jan. 27 issue of the Engineering Record, the one-legged derricks shown in the photograph proved very useful. Not requiring any elaborate track, they were easily moved, and brought the time and cost for installation on this work to a low figure. They were made over from standard traveler derricks, retaining the 20-ft. mast, 40-ft. boom, and the stiffleg beside which the hoist was mounted. The work of the other stiffleg is done by two guys, which are slacked off, taken in, or moved to new anchorages, as the progress of the traveler requires.

DERRICK, UNLIKE MAN, MOVES MORE EASILY WITH ONE LEG THAN WITH TWO

The work is in charge of H. B. Kelsey, superintendent, under George R. Johnson, district manager for the Foundation Company, contractor for the power plant.

Floor Plans Simply Marked Show When to Strip Building Forms

IN ONE CORNER of the field office of the Turner Construction Company at the plant in Hoboken, N. J., described in last week's issue, hung two large drawing boards hinged about one edge to form a rack of the style approved by art museums for displaying photographs. Instead of being covered with works of art, however, the sides of these boards were filled with diagrams of the different floors in the two units of the building under construction. Each floor plan was ruled off in small irregular blocks corresponding to the units in which the forms were erected and concreted. As the forms were erected for each of these blocks, the corresponding area on the proper floor plan was roughly hatched in one direction with a red crayon. As the concrete was poured in each section, the date of concreting was stamped in the corresponding section on the floor diagram with a rubber dater.

In this way the superintendent had a visible and easily consulted record of the progress of the entire work. The system made it possible to tell at a glance and with certainty what parts of each floor could be stripped as the work progressed. The diagrams thus afforded a more reliable and much more easily kept record than could be secured with any system of written reports.

The work kept track of in this way was carried out for the Hoboken Land & Improvement Company by the Turner Construction Company, for which Albert Larsen was superintendent.

First Aid as It Ought to Be, But Seldom Is

"TAKE him to the office!"

"But his leg's broke."

"Makes no difference. The doc can't walk them ties across the bridge and climb down that bank. Come on, fellows, pick him up."

Moving a man with broken bones before the parts have been properly secured is not the only offense perpetrated in the name of first aid after an accident on construction work. A few of the mistaken attentions that seem to be second nature with many construction men who have never been given definite instruction in first aid treatment have been aptly summed up by Dr. W. N. Lipscomb, field representative of the American Red Cross, who has been engaged in organizing first-aid work among the mills of members of the West Coast Lumbermen's Association in Oregon and Washington. Some of these pointers, which while known to every insurance physician cannot be repeated too often for the benefit of the layman, are as follows:

Never fail to give attention to a wound, no matter how small.

DON'T DRAG CLOTHING OVER WOUNDS

Never drag clothing over a wound, but cut or pull it away carefully.

Never put fingers or anything else into a wound for any purpose, and never wash out a wound with water, which may carry bacteria, and is therefore dangerous.

If proper first-aid material is not at hand, it is safer to expose a wound to the open air than to put a handkerchief or other material on it. When a doctor is not immediately available, apply one-half strength tincture of iodine to wounds and for one inch around the margin.

In case of a fracture, do not move a man even a few feet before properly securing the broken bones in place. To violate this rule may cause a much worse condition. Do not poke around or otherwise handle the injured part unnecessarily in seeking to locate the broken spot. Do not let the patient dictate some favorite method of treatment.

TREAT OPEN WOUNDS FIRST

If an open wound exists, treat it first. Then, unless a broken bone is protruding, straighten the limb gently and hold it in position while another person applies and bandages splints, which should be carefully padded with any soft material at hand. The leg can be straightened by grasping the toes with one hand and the back of the heel with the other, while the upper arm or forearm can be handled by grasping the shoulder or elbow or wrist and elbow, as the case may be. If the end of a bone is protruding, do not "wash" it or attempt to replace it. On the contrary, put a sterilized-gauze pad under the bone before applying the splints to prevent its returning to place.

If it should be necessary to raise the part in order to apply the bandages, do not do this, but slide the bandages underneath, using a thin, flat stick. The bandages should be tied outside the splints with knots, but should not be drawn too tightly.

It is always necessary to watch for and treat shock by lowering the head, loosening the clothing, keeping the person warm and handling him as gently and as little as possible.

Raise United States River Steamer by Pumping Out Hull

By W. E. DUNSCOMBE
Submarine Diver, St. Louis, Mo.

THE United States stern-wheel steel-hull river steamer "Nauvoo," which sank early in the year in Quincy Bay, Quincy, Ill., was recently raised by the writer without erecting bulkheads all around the deck. It is believed that this is the first time a river steamer of this class has been raised without resort to such a cofferdam. When the boat was raised, the temperature was 6 deg. below zero, and it was necessary to cut through the ice before the writer was able to do the necessary diving.

It was possible to close off the steel hull into several watertight compartments, which were pumped out with a 6-in. centrifugal pump, assisted by two 3-in. and two 4-in. steam siphons. The work was carried on from the sister ship of the sunken boat, the U. S. steamer "Muscatine," whose boilers supplied steam for operating the pumps. It took only 6 hours to empty the compartments in the hull of water and bring the vessel to the surface.

The work of raising the vessel was carried out by the writer for the Rock Island district office of the U. S. Engineer Corps, Major George M. Hoffman being the officer in charge of the district.

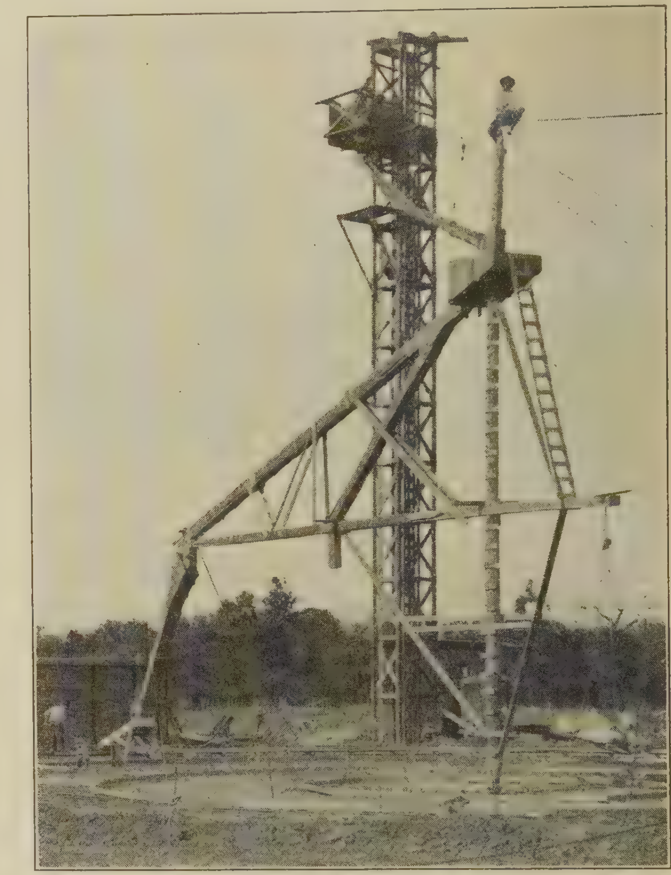
Revolving Mast Carries Spout for Concreting Circular Basins

By C. F. LAMBERT
Kansas City, Mo.

IN CONCRETING two circular concrete settling basins for the municipal waterworks of Brownwood, Tex., a central concrete plant was used for both basins from which concrete was distributed to the walls through a revolving chute supported from a ginpole set in turn at the center of each basin. The installation, which proved very successful, is plainly shown in the photograph.

Each of these basins has an inside diameter of 105 ft., with thin walls 10 ft. high. The walls, which are entirely above ground, are 6 in. thick at the top and 8 in. at the bottom. The basins are floored with 6 in. of concrete, sloped toward the center for drainage. At this point a 6-in. cast elbow connecting with the drain pipe is set. This elbow was placed first in each basin and used as a step for the ginpole. The pole was fastened by a guy spider and pin at the top, which left it free to revolve. Concrete was spouted from the central tower to a wood hopper built around the pole at the proper height, from which a second wood chute, supported from the pole as a boom, distributed it to the walls. An opening in the chute about half way down from which a vertical spout could be hung permitted concreting the floor without a return spout. When the first basin was completed, the pole and chutes were moved over to the second basin.

The obvious economy of this method of distributing the concrete could be taken advantage of in this sort of construction, where thin walls above ground had to be made absolutely watertight, because of the use of hydrated lime in the concrete. This was mixed with 1 part cement to 6 parts aggregate, the aggregate being a mixture of sand and gravel, which gave the proportion of an ordinary 1:2:4 mix. The hydrated lime used was about 10 or 12 per cent by volume of the cement. The 450 yd. of this concrete which was mixed with hydrated lime flowed very freely through the chutes, did not require an undue amount of water, and did not separate, and produced a smooth surface against the forms. The resulting construction was absolutely watertight. The basins were designed by the writer.



CHUTE AND MAST REVOLVE TOGETHER

Spontaneous Ignition of Charcoal

Spontaneous ignition of wood, according to a paper read by Frederick J. Hoxie at the annual meeting of the American Society of Mechanical Engineers, is undoubtedly intimately associated with spontaneous ignition of charcoal. In dwellings and factories many of the fires originate in the woodwork near steampipes or other heating appliances which are kept at temperatures far below the ignition point of wood and are the result of spontaneous ignition of charcoal formed by slow combustion over extended periods of time.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Debate Depreciation and Land at Valuation Hearing

Valuation Division Defends Omission of Reproduction Cost of Land—Discuss Joint Property

Depreciation and the treatment of land were the two big subjects that occupied most of the last four days of the valuation hearing in Washington last week, an account of the first two days of which appeared in last week's issue, page 201. In the Wednesday session, however, there was considerable debate over railroad crossings and also over industry tracks, which are two phases of the many-sided and perplexing problem of joint property—that is, property owned wholly or in part, or used wholly or in part, by other than the carrier under valuation. When the hearing adjourned Saturday noon, only the first group of issues, those not involving the taking of testimony, had been disposed of. The program is that examiners be appointed to take the testimony locally, and that the argument before the commission be resumed the week beginning March 19.

Assessments for Public Improvements

The first subject discussed Wednesday, Jan. 31, the third day of the hearing, was that of assessments for public improvements. W. G. Brantley for the A. B. & A. answered the claim of the Division of Valuation that these amounts are included in the added value of the lands by the contention that the carrier was entitled to that added value regardless of how it was acquired, and was in addition entitled to actual costs incurred. C. F. Newman for the Division of Valuation held that the theory upon which public assessments are made or allowed is that they enhance the value of the property. He held also that this has proved true in fact as well as in law, and that the carrier's theory would result in duplication. Thomas W. Hulme, vice-chairman of the Presidents' Conference Committee, suggested that assessments do not always increase value immediately, but often require heavy private expenditures to produce that value.

Railroad Crossings

Under the head of railroad crossings consideration was given to both grade crossings and separated grades. Mr. Brantley claimed for the A. B. & A. in reproduction the entire cost of either type of crossing where his road, as the junior, had been obliged to pay the entire cost.

Director Charles A. Prouty of the

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Gen. George W. Goethals Opens Consulting Offices

Gen. George W. Goethals has opened offices in New York City and will engage in a general consulting practice in civil, electrical, mechanical and hydraulic engineering. His associates, who, with the exception of George M. Wells, have not as yet been announced, will be experienced specialists in their particular lines. Mr. Wells has just resigned as resident engineer in charge, Division of Building Construction, Panama Canal. The firm will give special attention to examinations and reports on canals, harbors, drydocks, terminals, dams, water-power development, water supply, purification of tropical waters, refrigeration, reinforced-concrete structures, organizations, management and public utilities. The offices are at 43 Exchange Place, New York City.

St. Paul to Electrify Over Cascade Mountains

Electrification of the Chicago, Milwaukee & St. Paul Railway, already completed through the Rocky and Belt Mountains and nearly finished through the Bitter Root range, is to be extended over the Cascade Mountains. Announcement of the plans for this project has been made by C. A. Goodnow, assistant to the president of the St. Paul System. Four hundred and sixteen miles of the railroad's Puget Sound line is now being operated electrically and the work on 24 miles from East Portal to Avery, Idaho, is to be finished this month. The completion of this section of the work will complete the original electrification program of 440 miles. While it has not been definitely decided how soon the electrification over the Cascade Mountains to the Coast will be undertaken, it has been announced that the surveys are now under way.

Engineers Present Arguments for Nitric-Acid Plant

The contention that Muscle Shoals on the Tennessee River constitutes the best location for the proposed $20,000,000 government nitric-acid plant is set forth in a lithographed book placed before President Wilson in Washington, Jan. 22, by the Muscle Shoals Association. The book was prepared by the Nashville section of the Engineering Association of the South. The arguments put forward are embellished with colored photographs of scenes about Muscle Shoals, which lies 75 miles southwest of Nashville. There are numerous maps.

National Commerce Chamber Holds Fifth Meeting

Takes Action on Revenue Bill, Daylight Saving and Statistics of Inland Waterway Traffic

The Chamber of Commerce of the U. S. A., with more than 1200 delegates, representing 300,000 business men, in attendance, met in Washington, D. C., Jan. 31 and Feb. 1 and 2, and among other things took a strong position on the pending revenue bill, indorsed preparedness, the Webb bill and daylight saving; reaffirmed its stand in favor of a budget system for the national government and, in view of the present crisis, pledged the business interests of the country to support the President in any eventuality. One of the notable addresses of the meeting was that on industrial relations, by Harry A. Wheeler, first president of the National chamber. It is reprinted elsewhere in this issue. Of special interest to civil engineers was the passage of a resolution calling upon the government to collect with its own force statistics regarding the use made of inland waterways, such statistics to be used as a basis for determining the advisability of improving these waterways.

Chamber Financially Sound

The address of the president, R. Goodwyn Rhett of Charleston, S. C., showed that the chamber was not only in sound condition financially, but that it has had a great growth in the last year. More than 200 organization members and 2750 individual members have been added to the rolls, while the reaching of the limitation set on the number of individual members, 5000, suggested amendments to the by-laws. These amendments to the by-laws, brought up at the main business meeting of the session, were passed. They provide for two new classes of membership—associate and endowment. Associate members may be persons, firms or corporations, paying dues of $100 or multiples thereof per annum, and who are entitled to appoint a representative for each $25 paid. Endowment members are those who have contributed $500 or more, not including annual dues. These contributions are to go into an endowment fund, which, when the board of directors deems advisable, will be used to acquire a home for the chamber. Meanwhile the income from this fund may be used, if necessary, to defray the expenses of the chamber. Both amendments were passed.

After the War

One whole session, addressed by Secretary Redfield of the Department of Commerce; Dr. Leo S. Rowe, secretary of the International High Commission; Wallace D. Simmons of St. Louis, and Richard H. Waldo of New York, was devoted to conditions after the war and preparations therefor. Moreover, the report of the committee on the Department of Commerce, of which A. W. Shaw is chairman, dealt with this subject and proposed certain new activities for the department. Says the report:

"If there is one thing more likely than any other to defeat us in the world competition after the war it is this: That in the very nature of the case we are now being reminded constantly of the strong points in our position, while our three greatest foreign competitors are being reminded constantly of the weakness in theirs, i.e., that home efficiency is the key to prosperity."

After-the-War Problem

"It should help us to remember," the report adds, "that the 'after-the-war' problem, whether we look at it from the standpoint of foreign or domestic trade, is at the bottom just a problem in ordinary home efficiency. If we as American business men, individually and collectively, can produce and distribute with as little waste of materials, man-power and opportunity, as our foreign competitors, we shall get on comfortably. If we do not, our interests must sooner or later suffer. We may pile up wealth and gold reserves, establish scientific tariffs, negotiate the best of commercial treaties, carry on the most vigorous foreign trade propaganda, legalize combinations for exporting, we may do a hundred wise accessory things like these, but unless they are backed up by a business fundamentally as efficient as that of our competitors, they can give us no lasting security."

New Functions for Commerce Department

The report proposes the addition of four closely related new functions in the Department of Commerce, which would put it into a relation of everyday helpfulness to the business men, corresponding roughly to that which the Department of Agriculture now holds to farmers.

First, the department should find out what it costs to do business in the United States. As the department found out enough such facts to proceed with, it should, as its second new function, deduce from them sets of reasonably attainable standards, for the various items of expense in the various lines of business. The third new function would be to tell the manufacturer and business man, that is, to circulate information concerning the methods of the more efficient. The fourth new function would be the working out of still better methods than the department found in use in any actual business.

At the railroad session Walker D. Hines, chairman of the board of directors of the Atchison, Topeka & Santa Fe Railway, predicted that if Congress adjourns without passing the pending railroad disputes measure, there will be a strike of the railroad brotherhoods or at least the threat of a strike. He believed that the strike will come whether the Supreme Court declares the law constitutional or not. If the law is held constitutional, there will be so many adjustments to be made between the railroads and the employee that conflict is sure to result. [It may be mentioned that this prediction was made before the break in relations with Germany.]

The vote was announced on the referendum relating to the railroad problem. On the question of indorsing the measure forbidding a strike until the results of an investigation of the situation were made public, the vote stood 1226½ in favor and 18½ against. On the question asking if on any investigating board the employees and employers should have equal representation and the public as having the paramount interest, a majority, 1166½ votes were cast for and 59½ against the proposal. Finally it was voted 1171 to 70 that the Interstate Commerce Commission should establish a statistical division to study and compile statistics relating to wages and conditions of service, the records and statistics to be available to investigating boards.

Immigration

The committee on immigration reported the results of an inquiry touching on immigration after the war. The questions were sent to railroad passenger agents. The questions and returns are as follows: *Question A:* Are immigrants in America saving money to bring over aliens? *Answer:* Of the 934 replies received, a certain number are inclusive or vague, but the great majority are definite, and of the latter 71.6 per cent indicate that savings are being accumulated in considerable volume for this purpose, while 28.4 per cent report that among the people with whom they are in touch there is no movement in this direction. *Question B:* Does personal correspondence from Europe indicate a movement to this country? *Answer:* Of those replies giving any definite indications on the subject, 52.4 per cent indicate that it will be large and 47.6 per cent that it will be small. *Question C:* Will such immigration as does occur be from the farms or from the factories? *Answer:* While about one-third were unable to give any information on this subject, those who did report indicate that 69.8 per cent of the immigration will be from the farms and 30.2 per cent from the factories. *Question D:* After the war is over, will there be any considerable permanent emigration from this country to Europe? Of the replies 21.8 per cent report that there will be a large permanent emigration; 78.2 per cent report that it will be small. *Question E:* How great will be the movement of those going back to Europe temporarily after the war and who will return after a short visit? *Answer:* Of the replies, 57.5 per cent report that it will be large; 42.5 per cent that it will be small.

Resolutions

The main resolution introduced related to preparedness and the pending revenue bill. It created considerable discussion but finally carried by much more than a two-thirds majority, at least so far as could be judged by the viva voce vote. The resolution approved of the program of preparedness, as indorsed by the chamber's referendum and by various resolutions, and also pledged the support of the chamber to any just and reasonable taxation to support preparedness. The resolution protested against the inequitable and discriminatory taxation of the pending revenue bill providing for a tax on corporations and copartnerships, and finally, declared that the business men of the country would approve of any bill drawn along the lines of fairness "so that every citizen would pay his just share of the tax."

Statistics

Besides the resolution just referred to and those briefly mentioned in the introductory paragraph of this account, resolutions were adopted covering the following subjects:

The collection by the government itself of statistics regarding traffic on inland waterways, said statistics to be used in determining the advisability of improving these channels, and the creation of a salaried commission, composed of economists and statisticians, with a term of five years, to study the census and statistical machinery of the United States, in order to determine its efficiency and recommend changes and improvements so as to secure the best results from the government's statistical work.

Colfax-Larimer Viaduct in Denver Opened to Traffic

One of the largest viaducts in the country, the Colfax-Larimer X-shaped reinforced concrete structure in Denver, was opened Jan. 18. Including all its branches, it is 8479 ft. long, and varies in width from 36 to 68¼ ft. The cost was approximately $2 per square foot and $100 per linear foot, and is borne jointly by the city, tramway company and railroads. The structure, the second of its kind, consists of suspended spans alternate between sets of two cantilever towers—a form of articulated slab-and-girder construction which provides for settlement as well as expansion. Photographs of the structure were shown in Engineering Record, Aug. 28, 1915, page 263, and a description of the suspension detail was given on Oct. 17, 1914, page 428. H. S. Crocker, consulting engineer for all parties concerned, made the designs and supervised the construction. The general contractors were the C. S. Lambie Company, the C. P. Allen General Contracting Company and the Denver-Pueblo Construction Company.

Debate Depreciation and Land at Valuation Hearing

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Division of Valuation admitted that the problem had given the division much trouble, and that he was not wholly in accord with the course that has been adopted on the recommendation of the advisory and engineering boards. The plan adopted, however, was to get the carriers concerned to agree, if possible, as to the division of ownership. Failing in this, an arbitrary division was made on the basis of use and necessity. Thus, grade crossings would be divided equally, interlocking would be divided on the basis of use, as determined mainly by the number of levers used by each road, while in the case of undercrossings the higher road, being the one dependent upon the bridge, would be allowed the full cost.

It was the aim of the division to record all of the facts, and Mr. Prouty admitted that it would be necessary in some manner or other ultimately to allow the carrier all it had paid, even to the extent of extra money paid for the privilege of crossing. P. J. Farrell, solicitor for the division, held that this was the only feasible treatment of the problem, the only one that would avoid duplication.

Pierce Butler, for the Texas Midland, argued that in apparently making the whole allowance to both carriers there was no duplication. In the case of the undercrossing he held that the road using the bridge owned it as actual property, while the other road, if the junior, had paid the cost of the bridge for the right to cross. He held that every inch used by a carrier as right-of-way must figure in reproduction cost, and that the apparent duplication arose from doubled intensity of use.

Industry Tracks

Discussion of the general subject of joint or restricted use was continued under the head of industry tracks. The division's view, as voiced by Director Prouty, is that an industry track is a plant facility of the industry, and is not used for common-carrier purposes. The division, therefore, allows the carrier only whatever it could remove on termination of the contract between industry and carrier. The land occupied by industry tracks is allowed only when the carrier holds indefeasible title thereto, the test being whether or not the industry could interrupt the title of the carrier.

Mr. Butler contended that industry tracks were part of the terminals of the carrier, and that by relieving the traffic on other tracks for more general use they were clearly to be classed as for common-carrier purposes. This was substantiated, he said, by the car-spotting decision, the ability of the commission to fix rates for industries using the tracks, and by the right to condemn right-of-way to a single industry.

The contention of the carriers in all of these matters pertaining to joint property is that the division has changed the phrase "owned or used" in the valuation acts to "owned and used."

Depreciation

Mr. Brantley's view of depreciation was similar to that expressed by him at previous hearings, that on a road properly maintained there is no depreciation, that to estimate it on the basis of life tables applied to individual units is to indulge in mere speculation, that to deduct it is to write off a large part of the value of the carrier, and that the meaning of the Valuation Act is that deferred maintenance only should be recorded. Pressed by Commissioner Clements for a definition of a proper standard of maintenance, he said he could get plenty of experts to determine it. To Director Prouty's remark that no two of them would guess alike, he replied that no two of the division's field men would guess alike as to the remaining life of a car. In fact, he thought the same man would not guess the same car alike twice on different days. He thought there should be a joint board of the division and the carrier to determine proper standards of maintenance, and that the depreciation would be what it would cost to bring the property up to that standard.

What the Law Requires

Comments by several of the commissioners suggested their belief that any writing off of value could result only from the use made of the figure reproduction cost less depreciation, and not from the mere recording of it, which they appear to think is required by the Valuation Act. Director Prouty voiced the same view. He held that if the carriers insisted that there was no depreciation, they were likely to be confronted at a later date with arguments against allowance for depreciation in the earnings. He thought that examination of the facts would determine whether or not writing off depreciation would be confiscation. In the case of the A. B. & A. he admitted that it would be, but he stated that there were other cases where the depreciation had been much more than made good by excessive earnings. Both kinds of cases, he thought, must be dealt with.

The function of the division, he held, was simply to determine the number of service units which had been used up. The division was using the straight-line basis, which, he said, was too favorable to the carriers. They would ultimately, therefore, have to account for the interest.

Contrasting with the suggestions of the commissioners and the director that depreciation was to be found because the act required it and that this did not imply that it must be deducted to determine the rate base, Mr. Farrell read from the Knoxville water decision in support of the view that the deduction is to be made to determine the rate base. C. B. Aitchison for the states, following the same line of thought, read from the long list of decisions presented a year ago by the state commissions.

Mr. Butler supported Mr. Brantley's view, developing the idea that with a carrier of size renewals would be uniform from year to year, and would be accomplished by the replacement method, without the need for any depreciation fund. Answering Commissioner Daniels' query as to whether Congress intended the recording of two identical columns—reproduction cost new and reproduction cost less depreciation—for well maintained roads, Mr. Butler pointed out that the division had the same figures in both for land, grading and engineering.

The straight-line basis of depreciation, Mr. Butler thought, was entirely wrong, being based on the erroneous assumption of the division that all service units of a given item are equal value. The effect, he said, was especially noticeable in such long-lived items as masonry, in which, to offset an annual reduction in value of $1, by a method ignoring interest, the carrier would probably be allowed the much smaller amount that would produce $1 at the theoretical end of life of the item.

Other Lines of Investigation Suggested

Mr. Hulme asked that the division be instructed to pursue three lines of investigation, to determine (1) what deterioration took place during the construction and development periods, (2) to what extent there has been deferred maintenance and (3) to what extent inadequacy and obsolescence had bearing on the mortality tables used by the division. Director Prouty thought the second and third could not be answered, and Mr. Farrell thought the same of the first in the absence of a definition of the development period.

At this juncture the question was raised whether such general questions as whether or not original cost should be reported, and whether or not there are other values and elements of value, and whether or not there should be an ultimate signing of value, should be argued in full in the case of the Texas Midland Railroad. Mr. Butler stated that he did not think this should be done, as the Texas Midland could not afford to prepare the case well enough for a satisfactory test. Director Prouty agreed that the Kansas City Southern case, which is scheduled for argument the week of March 19, would present a much better test case. The division will not, however, have all its data available on this road before July.

Treatment of Land

Four issues were combined in the discussion of land, which consumed the last two days of the hearing. Practically the whole debate hinged on the interpretation of the Minnesota rate decision, all sides using it repeatedly to support their contentions.

Mr. Brantley, following the argument previously presented by the carriers, to which he referred, held that the decision in question established the cost to condemn the land as the proper basis of reproduction cost, and barred out only the additional value because of its railroad use. And the latter figure, he contended, was allowable as present value. He held that the division must give reproduction cost to comply with the law, and that its figure "present value," being only the average acreage value, was not present value at all, and was a worthless figure. He contended that it was pure conjecture, and unreasonable, to assume that acquisition cost once paid could be avoided in reproduction.

Impossible by Law

The division, on the other hand, held that cost of acquisition had not been determined both because it could not be done and the act could not require the impossible, and because the figure would be useless if obtainable. Questioned by Commissioner Clements, who appeared unconvinced of the impossibility of obtaining the figure and of the permissibility of omitting it if obtainable, even though useless, Mr. Farrell quoted an oft-repeated passage of the Minnesota decision to prove its impossibility. He went further, and urged the exclusion of evidence from the carriers to show what land would cost now, if introduced to prove the possibility of determining the impossible.

Mr. Butler stated that prior to the passage of the valuation act the general interpretation of the reproduction cost of land had been that of the carriers. He contended that the language of the valuation act was plain in calling for this figure, and quoted from the briefs presented by the state commissioners a year ago to show that they believed this to be the mandate of the act, which they thought would have been worded differently if it had been passed after instead of before the Minnesota decision. Mr. Butler held that the law must be obeyed.

The State's View

The Minnesota decision was pressed into service a third time by A. E. Helm, speaking for the state commission, who interpreted the familiar passages to mean that reproduction cost of everything—land, grading and all other physical plant—was definitely rejected by the commission, thus establishing original cost at the proper basis.

C. E. Elmquist, for the State of Minnesota, supplemented this thought by presenting again his theory of instantaneous reproduction, which is that, because of the impossibility of imagining the non-existence of the railroad with everything else remaining undisturbed, reproduction must mean simply the application of reasonable unit prices to the existing quantities. Taking one of the tentative valuations, item for item, he read the amounts, computed by his engineer, that he thought should be deducted from the division's reproduction cost new. They covered, among other things, clearing and grubbing, shrinkage, subsidence, hidden quantities, temporary trestles, hauling by teams and wastage, inspection and rehandling of materials of any sort.

Director Prouty expressed doubt as to the value of such an estimate and Commissioner Hall asked whether there was any element of fiction in imagining the building of a railroad overnight. The carriers, however, seemed willing to let the argument stand on its own merit.

The one other argument on a subject of land was novel only because of its author—the representative of the four railway brotherhoods. The justification of his appearance was that he represented annual wages equivalent to the interest on $30,000,000,000, as compared with a railway capitalization of $21,000,000,000. His argument was the agency theory, that the railroads owned no land, their charters denying them that privilege even though they held fee-simple deeds, and that therefore no unearned increment could be any part of their value for rate-making purposes.

As previously mentioned, argument is to be resumed March 19, testimony having in the meantime been presented locally to examiners to be appointed for the purpose.

National Commerce Members Sing at Smoker

Sung at the smoker of the National Chamber of Commerce last week at Washington, D. C.

TRAMP! TRAMP! TRAMP!

Conservation is the cry, cost of living
 is too high,
So we're going to build the Great
 Falls power dam.
Free electric lighting scheme,
Three-cent fare, a happy dream!
And we'll charge up all the bills to
 Uncle Sam.

Chorus:

Dam, dam, dam the old Potomac
 Where her waters rush and foam.
Talk about the River Rhine—
They have nothing half so fine;
We've a dam-site better here at
 home!

Falsework for Concrete Bridge in Spokane Collapses

Late on Tuesday, Feb. 6, the falsework of the new concrete bridge being erected over the Spokane River at Post Street, Spokane, Wash., collapsed. Only six of the twenty-five men on the work were accounted for at midnight. The wrecked falsework caused the river to back up and made rescue work difficult. City Engineer Morton Macartney stated Tuesday evening that the reason for the collapse was unknown. A full investigation will probably be made to fix responsibility.

New England Waterworks Men Meet Feb. 14

New England Waterworks Association will hold its meeting Feb. 14 at Boston. Frank Winsor, chief engineer of the Water Supply Board, Providence, R. I., will speak on the water supply of Providence. Forestry, in its relation to public water supplies, will be discussed by Prof. J. W. Toumey, director of the forestry school at Yale University.

Court Holds Flood Plans for Columbus Confiscatory

City Engineer Submits Modified Plans for Channel Improvements When First Plan Is Rejected

Flood-conservancy matters at Columbus, Ohio, are at a standstill. By a decision rendered Jan. 9, noted in these columns recently, the court held that the official plan, if assessed against the flood district in Columbus and Franklin County, would be confiscatory of the property. In deciding this question the court assumed for the purpose of the hearing that the plans are efficient and adequate and would afford the protection claimed for them by the engineers, Alvord & Burdick, who prepared them. No clew is given in the 4-page decision as to why the court should have reached such a decision, nor does it give any measuring stick by which an opinion might be formed as to what expenditure would be confiscatory and what would not be.

Modified Plan in View

Henry Maetzel, city engineer submitted a report Jan. 18 to the city council embodying two channel-improvement projects costing $3,500,000 and $4,500,000 exclusive of bridge change, to accommodate floods of 100,000 and 80,000 sec.-ft. The 1913 flood was 130,000 sec.-ft. Mr. Maetzel pointed out the inadequacy of the channels for adequate protection and strongly urged the construction of the Dublin dam in addition, which would just about safely protect against a recurrence of the 1913 flood.

This is the modified plan the conservancy district had in view; but competent engineers state that from a general conservancy standpoint it has no merit, for under it Columbus and Franklin County would be paying fully as much as under the official plan, should the cost of the latter be distributed over the whole benefited territory, from Delaware to Chillicothe. Furthermore, the protection is not as great, for the official plan provided for a flood 45 per cent in excess of that of 1913. As revised, however, the plan would be less burdensome upon the flooded district in Columbus, provided a way could be found for financing the channel improvements in Columbus with the $3,500,000 bond issue already voted, leaving only the dam to be assessed against the flooded district.

Propose New Outer Lane Driveway Over Chicago River

An outer driveway connection between the north and south sides in Chicago at the mouth of the Chicago River is contemplated in an ordinance introduced in the City Council Jan. 31. The proposed drive would connect Grant Park with the municipal pier by a monumental bridge over the mouth of the river. The cost is estimated at $1,500,000, and it is proposed that the expense be defrayed equally by the Lincoln Park and South Park boards.

French Buy American Construction Plant

Large Export Firm to Develop Demand That May Greatly Increase American Output

American manufacturers of concrete machinery, hoisting engines, excavating tools and other construction plant may find Europe, and especially France, Russia and Italy, markets which will justify a large increase in the capacity of their plants, according to Thomas Garrett, manager of the machinery department of Gaston, Williams & Wigmore, Inc. According to this firm, which has for some time been carrying on a large business in American manufactures and machinery with all parts of the world, France is likely to develop into an extraordinary market for such tools. With a population practically two-fifths that of the United States, and nearly one-half of which has heretofore been engaged in or supported by agriculture, France has up to the present carried out practically all of her public works without any of the tools developed in America for doing such work.

First Concrete Spouting Plant Shipped

Indeed, the first concrete spouting plant for building construction ever seen in France, so far as can be ascertained, is one which the corporation mentioned shipped to a French building contractor last week. As pointed out by Mr. Garrett, the population of the United States is so much smaller in proportion to the area developed than in European countries that the construction work carried on here is much more extensive in proportion to the population than is the case with any country in Europe, perhaps including even Germany. Hence the more advanced development in the United States of construction machinery. The war, however, has put a premium on all sorts of machinery that saves hand labor.

While in most European countries this condition has so far resulted in a demand for equipment to manufacture war supplies, it is expected after the war to result in a similar demand for the tools used in carrying out construction work. In fact, construction work is already under way in France on an extended scale because of peculiar conditions. With the larger part of its manufacturing territory, including most of its coal mines, in the hands of an invader, France has been faced with a situation in which it was necessary to carry out a great deal of industrial construction, and to develop the water-power resources of the country in order to lessen the seriousness of the loss of the larger part of the country's fuel supply. Moreover, extensive port and harbor improvements are under way or projected.

Construction Department in Charge of Noted French Engineer

Both on this account, and because France is more readily accessible to the corporation mentioned, which owns and operates a fleet of 14 vessels between European and American ports, it was decided to develop a European market for American construction machinery first from Paris, where the French company of Gaston, Williams & Wigmore, Inc., has its offices at No. 5 Rue Daunaw. The construction department just established for this purpose has been put in charge of H. G. Harms, a French engineer who has been connected with many important public works in that country and who recently spent five years in the United States.

The present plans of the company are to make arrangements with American manufacturers of contractors' equipment for the supply of this equipment as it is sold abroad, the American firms being paid when the machinery is shipped from their factories, and the export firm collecting from the French consignees. Necessary repair parts for the lines of equipment handled will probably be carried in Paris, and it is expected that the demand will develop to a point where it will prove profitable to establish factories for assembling some of the equipment abroad. American workmen and construction men will be required at first to show the French how to use these tools.

Gasoline or Electric Drive Preferred

Electrically driven equipment, or cranes, concrete mixers and hoists operated by gasoline engines are preferred to steam equipment in France, according to Mr. Garrett. Although gasoline is more expensive there than in the United States, it appears to be more desirable as a source of energy than coal, and is likely to be employed where electric current is not obtainable. It is expected that the market will prove a profitable one from the start, in view of the many inquiries which this company has already received both from French contractors and from French capitalists who expect to undertake construction work. Many of these inquiries come in the form of letters to which advertisements cut from American engineering publications are pinned.

While it is impossible to predict at present to what extent Germany's new submarine campaign will interfere with freight service between this country and Europe, neither it nor the liability of the United States' participating in the war is expected to have any unfavorable influence on the enterprise outlined. On the contrary, it is believed that the entry of this country into the conflict would, if anything, foster closer relations and make the task of introducing American products abroad an easier one.

Round-Table Talks to Feature Indiana Sanitary Meeting

Round-table discussion at each of the four business sessions of the Indiana Sanitary and Water Supply Association are to be a feature of the convention to be held in Indianapolis Feb. 14 and 15.

What Engineers and Contractors Are Doing

ARTHUR M. PORTER has resigned as city engineer of Redwood City, Cal., and has been succeeded by C. L. Dimmit.

T. MOOTE has resigned his position with the Illinois Central Railroad to enter the employ of the Standard Oil Company of Indiana, at Whiting, Ind. Mr. Moote, a graduate of the University of Illinois, class of 1916, is also a graduate of the Oklahoma Agricultural and Mechanical College, class of 1910. From 1910 to 1911 he was with the Santa Fé system in Texas. For the next three years he was engaged in mountain railway work in South America with the Antofagasta & Bolivia Railway.

HARRY N. JENKS, recently employed to report on the sanitary precautions to be observed and watershed regulations to be formulated in the Mount Tamalpais region in constructing the new $3,000,000 water supply of the Marin Water District, California, has been retained for two years as sanitary engineer with the Burma Mines, Ltd., Namtu, Northern Shan States, Burma, India. Mr. Jenks' work will include many phases of tropical sanitation as well as general engineering work. Under Prof. Charles Gilman Hyde he assisted in the preparation of the report on possible sources of water supply for the city of Sacramento.

JOHN D. MATTISON is with the Sinclair-Cudahy Pipe Line Company, drafting department, Tulsa, Okla. From the time of his graduation from the University of Illinois in 1915 to the first of this year Mr. Mattison was employed as junior engineer with the Illinois State Highway Department.

E. KEMPER CARTER has resigned his position of city engineer and superintendent of waterworks, Liberty, Mo., to represent the Standard Asphalt & Rubber Company, of Chicago, in the territory of Missouri, Iowa, Kansas and Nebraska, with headquarters at Liberty. Mr. Carter has been with the city of Liberty four years, going there in 1913 from St. Louis, where he was with the Southwestern Bell Telephone & Telegraph System. Previous to that time he was assistant city engineer of St. Joseph, Mo. He is a graduate of the University of Missouri.

NATHANIEL S. THAYER has been appointed district highway engineer by the Minnesota State Highway Commission, with office at Worthington, Minn. He is also in charge of the highway work in Nobles County, succeeding D. E. Davison, who goes to Rock County. During the past year Mr. Thayer has been assistant district engineer of Martin and Murray counties, and previous to that was employed by the Massachusetts State Highway Commission.

Frank Payne, formerly with the Illinois Traction Company, later chief engineer of the Southern Illinois Railway & Power Company at Harrisburg, Ill., has been appointed general superintendent and chief engineer of the Southern Illinois & St. Louis Railway, with headquarters at Marion, Ill.

W. G. Caples, who has been appointed major of the First Battalion, Second Regiment of Engineers, in the field in Mexico, has been in charge of the Fourth Mississippi River District at New Orleans since 1914. Following his graduation from West Point in 1901 Major Caples' duties led him into the Philippines, where for two years he was engaged on road work and surveys for military posts and waterworks systems. After returning to the United States in 1903 some of his various duties to the date of his last appointment were road mapping, dredging operations, the design of snagboats and dredges and the development of processes of military lithography and sketching.

Caryl W. Wilson, of Sandpoint, Idaho, is now county engineer of Bonner County, succeeding Clyde J. Chaffins.

L. L. Baumgartner was recently made city engineer of Decatur, Ind.

O. W. Mountfort has resigned the position which he has held for six years in the construction and valuation departments of the Boston & Maine Railroad to enter the employ of the valuation department of the Pennsylvania Lines West of Pittsburgh as bridge pilot engineer. He is engaged at present in the field inventory of bridges in connection with the structural party of the Interstate Commerce Commission.

C. B. Mautz has resigned the position of assistant engineer, Chicago & Eastern Illinois Railroad, to join Mr. Putman under the firm name of Putman & Mautz, civil and mining engineers, Benton, Ill. At the time of leaving Mr. Mautz had been with the railroad for seven years, where his last position was engineer in charge of construction work at Danville, Ill.

S. D. Bacon has been appointed division engineer, Texas & Pacific Railway, with offices at Marshall, Tex., to succeed H. P. Mobberly, resigned.

Arthur J. Rhodes has been appointed city engineer from the position of assistant city engineer, Manhattan, Kan.

John E. Williams, county surveyor of Pottawatomie County, Kansas, has been appointed county engineer of Shawnee County, with headquarters at Topeka, Kan., succeeding Walter Arnold.

D. Gaston Wilkinson has resigned as assistant county engineer, Clarke County, and taken charge of highway and bridge construction in Marengo County, Alabama. Mr. Wilkinson after being graduated from Alabama Polytechnic Institute in 1905, spent several years on railroad location and construction in Alabama, and old Mexico. In 1909 he resigned the position of resident engineer, Mexico City Light & Power Company, to return to Alabama, where he engaged in general engineering practice until 1915, when he entered highway work.

Bert W. Macy, whose name appeared in this section in the issue of Jan. 20 as city engineer of Salem, Ore., is attorney for that city. Walter Skelton is city engineer.

Samuel J. Humes, county engineer, King County, who took office Jan. 8, succeeding Arthur P. Denton, has appointed the following office aids: Chief deputy, Carl E. Morford; office assistant, C. P. Mowry; court engineer, R. B. Higbee; bridge engineer, Frank K. Adams.

Fred Langford has been appointed city engineer, Sunnyside, Wash.

R. K. Stockwell, who has been chief engineer and superintendent of construction for the Braden Copper Company at Raucaque, Chile, for the past five years, will open a Western engineering and sales office of the Robins Conveying Belt Company in Salt Lake City. Mr. Stockwell while in Chile had charge of the civil and mechanical engineering work in connection with the construction of copper ore mills, electrolytic leaching, refining plants, mine structures and equipment, and other construction work at the copper mines. Before going to Chile he had eleven years of varied experience in the United States, chiefly in connection with steel mill machinery and smelting, refining and mining operations.

Cattell, Howard & Ashton, engineers, San Francisco, have announced that they have incorporated the firm and are prepared to undertake the following lines of work: Steam and electric railroads, bridges, buildings, foundations, harbors and terminals, water-supply and irrigation systems, industrial and manufacturing plants, sewers and sewage disposal, power developments and valuations.

George D. Whittle has accepted an appointment as highway bridge engineer in the Office of Public Roads and Rural Engineering, Washington, D. C. After he was graduated from the Massachusetts Institute of Technology in 1908 Mr. Whittle spent six years on railroad and municipal work in Texas and California, and during the last two and one-half years he has been in the bridge department of the California Highway Commission at Sacramento.

R. L. Whitcomb, until recently assistant valuation engineer for the Philadelphia & Reading Railway, will enter the general contracting business, organizing the firm of Sobray-Whitcomb Company, 17 West Forty-second Street, New York City. Mr. Whitcomb was previously engaged in heavy concrete and railroad construction. The new firm will make a specialty of reinforced-concrete design and construction and also will engage in railroad valuation.

J. E. Heiskanen has left the Moulton Engineering Corporation, Portland, Me., where he was employed as designing engineer, to accept a position as chief draftsman with the American Writing Paper Company, Holyoke, Mass.

W. C. Swett recently left the employ of the Kansas City Terminal Railway Company, where he was connected wnth the bridge department, to enter a similar department of the Chicago & North Western Railway.

Walter Kidde, engineer-constructor, 140 Cedar Street, New York City, has incorporated his organization under the name of Walter Kidde & Company, Inc. The combined construction and equipment of factories is to be one of the organization's specialties. Among its most recent commissions is the plant of the American Hard Rubber Company, at Akron, Ohio, which has buildings covering nearly 10 acres. The company is also prepared to handle projects such as harbor work and piers, chemical manufacturing plants, foundries, etc. The organization includes departments of construction, hydraulics, steam and mechanical engineering, electrical engineering and chemical engineering. Mr. Kidde, a graduate and trustee of Stevens Institute of Technology, will have with him his old associates as directors and stockholders of the new corporation. The officers of the company are: President, Walter Kidde; vice-president, B. G. Worth; secretary and treasurer, I. R. Lewis. Additional directors include Henry Lang, vice-president of the Ingersoll-Rand Company, and E. S. Boyer, who is associated with the American Hard Rubber Company. Other members of the organization include A. B. Miller, Walter S. Wainwright, M. I. Buttfield and E. Schwarz.

Revoe C. Briggs has been transferred from aid in the U. S. Coast and Geodetic Survey to junior engineer in the Water Resources Branch of the U. S. Geological Survey. He is for the present assigned to the Oregon District, with headquarters at Portland.

J. B. McClain has been promoted from resident engineer to assistant bridge engineer with the Seaboard Air Line Railway. Mr. McClain has been with the Seaboard Air Line since 1906, when he started as bridge inspector and in 1911 was made resident engineer. During the past 10 years he has been in charge of the largest and heaviest bridge work put in by the road. This includes the Lincoln Street viaduct at Columbia, S. C., containing 131 spans and 242 separate pieces of masonry work; the Savannah River bridge, consisting of seventy-five 50-ft. girder spans, and the 2000-ft. reinforced-concrete Duval Street viaduct at Jacksonville, Fla.

Bliss & Lavalle, architects and engineers, of Springfield, Mass., have associated with them F. R. Comstock, architect, formerly of Hartford, Conn., and New York City. Mr. Comstock has erected buildings in forty different states and in Canada.

George C. Bunker, physiologist in charge of Canal Zone water purification, has returned to the Panama Canal after an investigation of the water supplies available for the U. S. Naval Station, Guantanamo Bay, Cuba.

A. V. Duncanson has recently accepted a position with the Minneapolis Park Board. After spending three years at the University of Minnesota he was engaged as cost engineer on the Minneapolis Filter Plant and with the Calgary (Alta.) Water Department. He has been engaged in valuation work with the Minneapolis Gas Light Company, with the Duluth Edison Electric Company and with the Twin City Rapid Transit Company.

Newton A. K. Bugbee has been appointed state comptroller of New Jersey. The office is for a three-year term and carries with it a salary of $6,000 per annum. Mr. Bugbee was formerly president of the Engineers' Club of Trenton and is secretary-treasurer of the Newton A. K. Bugbee Company, Inc., engineers and contractors, Trenton, N. J.

I. W. Geer, general superintendent of the Central System of the Pennsylvania Lines West of Pittsburgh, has been transferred to general superintendent of the southwest system, with headquarters at Columbus, Ohio. Mr. Geer was graduated from Yale University in 1895, and has been with the Pennsylvania Lines since that year, working up through the positions of assistant engineer, engineer maintenance of way and division superintendent.

S. B. Robertson, until recently superintendent of the Cleveland & Pittsburgh division of the Pennsylvania Lines West of Pittsburgh, has been promoted to general superintendent of the central system of the Lines West. Mr. Robertson was born at Milton, Mass., on July 21, 1878, and was graduated from Massachusetts Institute of Technology, class of 1899. Following his graduation he had a year's experience on railroad bridge work as draftsman, and in 1900 entered the service of the Pennsylvania Lines West of Pittsburgh as assistant on engineer corps, Pittsburgh division. Later he was promoted to assistant engineer, and in December, 1904, was appointed division engineer of the Indianapolis division. He was advanced to superintendent of the Erie & Ashtabula division in 1911, and on July 1, 1915, was appointed superintendent of the Cleveland & Pittsburgh division.

R. H. Simpson, engineer with the Board of Public Works, Columbus, Ohio, has been appointed in charge of the subdivision of river channel improvement—a newly created division under George A. Borden, service director. R. C. Chaney, assistant engineer in the grade-crossing department, and F. L. Simons in the street-construction department, have been assigned to Mr. Simpson as assistants.

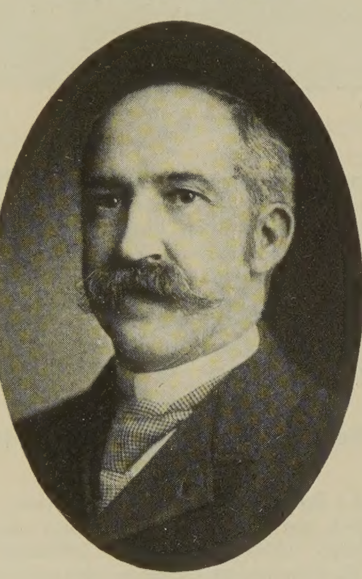
J. A. Nelson has resigned from the position of vice-president of the East Jersey Pipe Corporation, and is at the present time taking a vacation and rest.

Obituary Notes

Oliver Howell Crittenden, chief engineer of the International & Great Northern Railroad, died Jan. 27 at his home in Houston, Tex.

Lyman Edgar Cooley, one of Chicago's most noted consulting hydraulic engineers, died Feb. 3 at his home in Evanston, Ill. Known chiefly for his connection with the Sanitary District of Chicago almost continuously since 1885, he was also identified with numerous other hydraulic projects in this country. He has appeared often before state and federal bodies, and as late as March, 1916, before the committee on flood control of the House of Representatives. Mr. Cooley was born in Canandaigua, N. Y., Dec. 5, 1850, and was graduated from the Rensselaer Polytechnic Institute in 1874. For three years he was professor in Northwestern University and for the next two years was associate editor of *Engineering News*. In 1878 he was assistant engineer on the construction of a railway bridge over the Missouri River at Glasgow, Mo. Then, until 1884, he was assistant U. S. engineer on the Mississippi and Missouri River improvements. The same year he took up, for a brief period, editorial work on the *American Engineer*. In 1885 he became projecting engineer for the Chicago Sanitary and Ship Canal, being in turn assistant and chief engineer, trustee and consulting engineer. Some of the other projects with which Mr. Cooley has been identified are as follows: Consulting engineer on the contractors' and engineers' trip to Panama and Nicaragua in 1897-98; advisory engineer, Erie Canal; consulting engineer, Denver Union Water Company on the Cheesman dam; member U. S. postal committee on pneumatic tubes for mail in cities; projecting engineer for water-power development at Keokuk; secretary and consulting engineer, Internal Improvement Commission of Illinois, 1906-09; consulting engineer, Lakes to Gulf Deep Waterway Association since 1909. His consulting work with the Sanitary District terminated barely a year ago, and although failing sight rendered reading difficult, he was active to the last, speaking only a few nights before his death at a meeting of the Western Society of Engineers. He was a past-president of this organization, and as one of the early members he had much to do with maintaining its autonomy. He was also a member of the American Society of Civil Engineers and the American Waterworks Association.

Noted Consulting Hydraulic Engineer Who Died Feb. 3

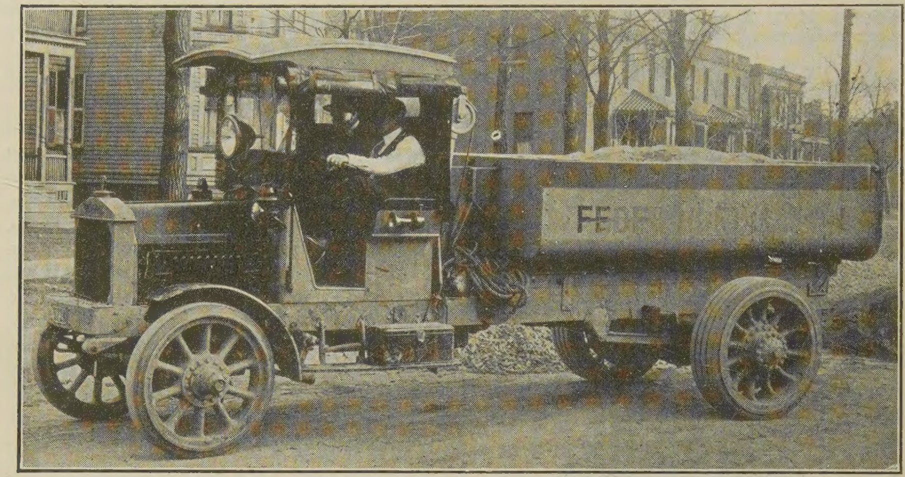


LYMAN EDGAR COOLEY

Samuel Forsythe Thomson, civil engineer, died Jan. 30 at his home in Brooklyn, N. Y. Dating from the time of his graduation in 1896 from the Massachusetts Institute of Technology, Mr. Thomson's life has been spent largely in the service of the public in and around New York City. One of the two exceptions when he was not so engaged was during a period of 5 years when he was connected with the faculty of the U. S. Military Academy, West Point, N. Y. Following his graduation he joined the engineering staff of Col. George E. Waring, Jr., commissioner of street cleaning, New York City. After two years of general municipal work he went to West Point as assistant professor of civil and military engineering. Following this he was for a short period connected with the commission on additional water supply for New York City. In 1903 he entered the service of the New York Rapid Transit Commission, where, among other duties, he had charge of construction, under Robert Ridgway, of the East River tunnels. He was one of the first engineers to be connected with the Board of Water Supply, where he was acting division engineer of the Wallkill Division under Mr. Ridgway. Three years ago he returned to New York City with the Kingsbridge Construction Company, with which firm he was engineer on several contracts connected with the New York Subway. He was a member of the American Society of Civil Engineers, the New England Waterworks Association and of the Municipal Engineers of the City of New York.

Introduce 5-Ton Truck

The Federal Motor Truck Company of Detroit announces a new 5-ton model in addition to the firm's usual line of motor trucks. Before adding this new model to its line the Federal company drove the car thousands of miles up severe grades and over all sorts of roads that the tryout might be most thorough. One of the tests consisted of a trip of 1176 miles. The 5-ton truck was loaded with sand, driven from Detroit to Pittsburgh, and then back to Detroit over Pennsylvania, Ohio and Michigan roads. For three weeks the truck was driven up and down well-known Pittsburgh grades.



NEW MODEL 5-TON TRUCK MADE IN DETROIT

The mechanical features of the new model, which is a larger edition of the 3½-ton Federal, include the worm-drive rear axle, heavy motor with five-bearing crankshaft of nickel chrome steel and force-feed lubrication operated at a pressure of 150 lb. The cylinder block has separated heads to each cylinder to allow the combustion chambers to be machined inside, thereby insuring even compression.

An inclosed dry plate clutch connects the motor with a four-speed transmission mounted "amidship"; this, in turn, is connected with the rear axle worm shaft by a tubular propeller shaft with inclosed universal joints. Springs of strong chrome vanadium steel, radius rods, and hollow-spoke steel wheels are special features of the new model. The chassis was provided with a steel hydraulic dump body which, filled with sand, made a total load of 20,000 lb. The Federal engineers express gratification at the way the motor has handled this load on severe grades.

Screw Extractor Useful in Field and Shop

A new tool, called the Ezy-Out screw extractor, is manufactured in a range of sizes that make it useful in the field as well as in the shop. The principle of its operation is much the same as that employed by the ordinary corkscrew, as it bites its way into the cork, secures a purchase and then backs the cork out. Ezy-Out backs the broken screw out on its own threads.

When a screw or stud snaps off, it is necessary only to drill a small hole in the broken screw and insert the extractor. It is given a slight twist to the left to seat it firmly in the hole. As it is twisted, its left-hand corkscrew-like spirals grip the sides of the drilled hole and exert a twisting, or rather untwisting, action on the broken screw.

The tighter the screw sticks the harder the tool grips, and when a wrench is brought into play, it is claimed that the screw will begin to "come" with very little trouble. The extractor is made of very tough steel, specially treated to withstand torsional strains. A folder describing Ezy-Out and its operation has been prepared by the manufacturer, the Cleveland Twist Drill Company.

New Stump Puller Will Reduce Cost of Clearing

A new stump pulling device, by which the cost of clearing land can be greatly reduced, has been invented by F. K. Kirsten, assistant professor in the electrical engineering department of the University of Washington. The puller is stationary, and it is said that ten acres can be cleared without moving the machine. The device consists of a bell-shaped drum, a long cable and a long steel arm. A stump is shaved down until it will allow the drum of the machine to fit over it. This is used as an anchor from which the cable is attached to the stump that is to be pulled. The steel arm is attached to the drum and horses are hitched to the arm. The cable tightens as the drum is turned by the horses and the stump is pulled. The pulling power of the horses can be multiplied any desired amount by increasing the length of the arm.

Professor Kirsten has used the new device on his Pierce County farm and finds that it works well.

Trade Publications

The following companies have recently issued trade literature:

Cement Tile Machinery Company, Waterloo, Iowa. "The Concrete Dope Book," second edition; dedicated to users and prospective users of Winner concrete mixers; 24 pages, illustrated, and full of information for concrete users.

Erie Machine Shops, Erie, Pa. Catalog and description of Erie tandem rollers.

American Cement Machine Company, Keokuk, Iowa. Catalog, 17; 30 pages, illustrated, describing mixers, powers, hoists and backfillers.

Barber Asphalt Paving Company, Philadelphia. "Barber Wood Block Book," 18 pages, illustrated.

Vanadium - Alloys Steel Company, Pittsburgh. Folder describing Vasco-Marvel, a semi-high-speed steel.

Sun Company, Philadelphia. Three 6 x 9-in. booklets devoted to Sun oils, ranging from 32 to 94 pages each. Vol. 1 is devoted to historical matters, Vol. 2 to production and Vol. 3 to pipe line and terminals. Much valuable information is contained in these booklets, more of which will be issued from time to time.

Barrett Company. Several booklets on Holt roof vent and leader connections, how to make form timbers rot-proof, and long life for wood at low cost.

Alpha Portland Cement Company, Easton, Pa. Catalog devoted to Alpha cement and telling how to use it. Ninety-six pages of illustrated information well worth having. Tables and drawings help to make the volume more interesting.

North Western Expanded Metal Company, Chicago. Booklets discussing wooden walls and ceilings for residence construction and expanded metal machine and belt guards.

Arc Welding Machine Company, New York City. Treatise on arc-welding operations and machinery, 34 pages, illustrated. Price $1.

Western Electric Company. Electrical supply year book for 1917. More than 1300 pages, describing the firm's products. Indexed and illustrated.

Stephens - Adamson Manufacturing Company, Aurora, Ill. Title, "S-A" Labor-Saving Machinery. A reference book of information relating to the design and application of conveying, elevating, screening and transmission machinery and accessories. Cloth-bound, well illustrated and indexed. Besides the many blank note pages the volume contains 886 ages describing the company's products. Useful tables, diagrams and information are generously included in the contents of nearly every page.

Republic Creosoting Company, Indianapolis. Folder reprinting paper by P. C. Reilly on proper oil for treating creosoted wood paving blocks.